Railway Age

DAILY EDITION

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EDITORIAL

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Contents

The Specifications for Timber

Among the important subjects presented by the Committee on Wooden Bridges and Trestles yesterday morning were the specifications, classifications and grading rules for timber and lumber for use in maintenance work. These specifications strike at a condition which has long prevailed on the railways and which has been complained of by the manufacturers of lumber. It is unfortunately true that there is much merit to the criticism often voiced by lumber manufacturers that there has been no uniformity of specifications, grades or sizes of timbers required by the railroads, each road being a law unto itself in this respect. This wide variation in opinion has made it difficult for lumber manufacturers to proceed with the cutting of timber in advance of definite orders, for there was no assurance that these orders would include timbers of the sizes on hand. However, the position of the lumbermen has also been open to criticism in that they have endeavored to induce the railways to accept their stock sizes rather than those actually required by the roads. These conflicting viewpoints have tended to create a controversy in which the advantage has been first on one side and then the other. In revising the specifications for maintenance of way timber the committee has endeavored to present standards which all of the roads can adopt. If the roads will adopt these specifications and standards the criticisms of the manufacturers will have been removed in large measure and they will be able to proceed with the production of their materials, knowing that they will comply with the requirements of many railroads. Once these specifications come into general use it becomes the duty of the lumber manufacturers so to cut their products as to meet the requirements of the railroads, since the railways, as purchasers, should be best qualified to pass upon the sizes and other conditions necessary to fill their requirements.

Every Member Responsible for Discussion

One of the tendencies which has been developing in the convention during recent years and which was particularly pronounced this year has been the lack of interest in the discussion of many of the reports. This may be due in part to a feeling among the members that the conclusions of a committee have been so thoroughly considered that further discussion is unnecessary. It may be due in even greater measure to a natural hesitation on the part of many members to speak before a large audience, or to take issue with the committee. Regardless of the case it is an unfortunate tendency which should be corrected. Few committees contain within their membership all of the sources of knowledge on a particular subject. There are few reports on which further discussion and information will not contribute to the value and possibly lead to a modification of the recommendations and conclusions of the committee. The object of the Association is pointed towards the development of the best practices. Any member of the Association who withholds information which might add to the knowledge of a subject is depriving the entire railway industry of this help. Since the most accurate conclusions can only be drawn by incorporating all of the information available it is important that this information be drawn out in the discussion if it is not contained in the report itself. This entails an individual responsibility to the Association which every member assumes when he joins it.

A Field for Further Service

The report of the Committee on Masonry contains a valuable suggestion for advancing the usefulness of the A. R. E. A. to the roads through the more intensive dissemination of information developed by the committees in the course of their work. The suggestion made by the Masonry committee relates to its own work, completed last year, namely, the Specifications for Concrete and Reinforced Concrete, but the same thought will apply to the work of other committees. It is proposed that these specifications be issued in pamphlet form in the same manner that the Specifications for Iron and Steel Structures have been published in various editions since they were first promulgated in 1906. The suggestion of the Masonry committee, however, goes further than this. In addition to the specifications *per se*, it is suggested that the pamphlet include a general fund of useful information on the subject of good practice in workmanship and material. In other words, it is proposed to prepare a fund

of data to support the requirements of the specifications couched in language that will appeal to the foremen and the inspector—the men who must be depended upon to secure the results. As pointed out by Mr. Robinson in his discussion, the real need is for simple statements of facts that the foreman can understand readily and put into use. Others may feel that a more comprehensive treatment would be preferable. Although there is thus an opportunity for a difference of opinion as to the character of information which should be included in such a pamphlet, it is believed that its publication will be an effective measure for the advancement in concrete practice on the railroads.

A Fair Presentation of the Facts

The reports of two committees presented yesterday bring out one of the most knotty problems now before the structural engineer. With all the scientific effort being directed at the perfection of concrete technology and for the improvement of timber treating practice, the use of both concrete and treated timber in sea water is attended with all too frequent failures. In neither case can the problem be said to have been solved satisfactorily. In each case there is a vast fund of conflicting data in which the results of imperfect practice are confused with conditions that indicate bona fide limitations of the present state of the art. Good results and long service records mingle with inexplicable cases of exceedingly short ones. The reports of these two committees presented yesterday were exceedingly frank in pointing out the limitations in the present use of the materials, one in the presentation of rules calling for very conservative use of concrete and the other in pointing out the shortcomings in the service secured from the creosoted piles exposed to the attacks of borers. In view of the fact that the constructor is practically limited to concrete and timber in his selection of materials for railroad works built at tidewater terminals, the presentation of the unvarnished facts concerning both of them is of inestimable value to the user and surely will accrue also to the ultimate advantage of those who supply the materials.

The Ravages of Marine Borers

In its report presented yesterday morning the Committee on Wood Preservation called attention to the severity of the recent attacks of marine borers on exposed piling in coastal waters and described various means of arresting these attacks in their entirety or in part. While this subect has received considerable attention for a number of years because of the known attacks along the Atlantic Seaboard and the Gulf Coast, the recent unusually severe invasions in San Francisco Bay and along Puget Sound have directed increased attention to this subject. The depredations within the confines of San Francisco Bay alone are estimated to have caused damage exceeding $15,000,000 within the last two years. In view of the decreased first cost of timber construction, it is important that means be discovered to overcome this trouble at the earliest possible date. The Committee on Wood Preservation has no more important work before it than to bring these investigations to a successful conclusion, for unless the proper precautions are discovered, the use of timber will of necessity be abandoned where marine borers exist. The present conclusions of the committee that the timber should receive a thorough treatment with creosote oil and that at points of particularly severe attack it should also be given mechanical protection as well, should receive the serious consideration of all engineers charged with responsibility for the construction of docks and other structures in sea water.

Plan for the Future Now

THE MEASURE OF SUCCESS OR FAILURE achieved in business concerns, as in the lives of individual men, is mainly determined by whether they do or do not make thorough and intelligent plans for the future, and resolutely endeavor to carry them out regardless of the difficulties they meet. Often after plans are made it is necessary to modify them or carry them out less rapidly than was hoped, but it remains true that large success is almost universally the result of sound and thorough planning and of resolute endeavor regardless of obstacles.

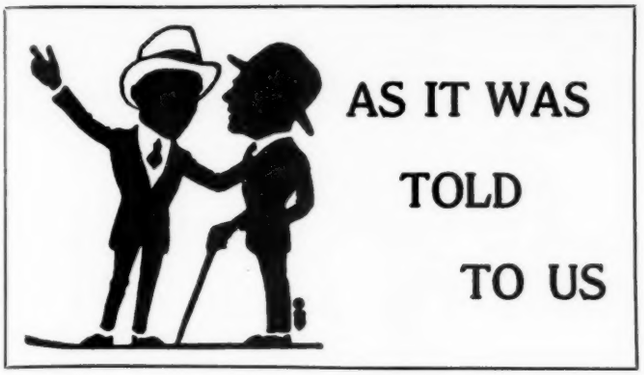
There never were any concerns for whose future development and successful operation careful planning was more needed than it is now needed for the railways of the United States. Conditions of almost all kinds in the railroad field have undergone violent changes within the last four years. Furthermore, most plans for the development of the railways which were made prior to four years ago have had to be kept largely in abeyance since then. Consequently, there are few railways which would not benefit greatly by having a complete survey made of their present and probable future needs and definite plans made for their future development.

The present needs of most railroads are different from what they were a few years ago. This statement applies to their position both from the standpoint of their physical condition and their organizations. Never was there a time when the development of the railways and their organizations along lines which would enable them to reduce operating expenses and give better service was so imperatively required as at present.

In the making of any survey of a railway to determine its needs and the means which should be adopted to meet them, the engineering department necessarily will play an important part. The engineering officers should make every effort to equip themselves to do their part in solving the great problem presented and they should not hesitate to direct the attention of their superior officers to the necessity for beginning to plan now. The time to make plans is when business is bad. There is less time and opportunity to make them when business is good.

Of course, every suggestion for improvements which is offered will be met with the answer that the railway has not and cannot raise the needed capital, but every railway under anything like normal conditions has some money to invest, and the smaller the amount the more necessary it is to spend it where it will do the most good. Only by careful study and planning can every available dollar be invested at the time and in the place where it will contribute the most toward the improvements which will increase the net return required to enable larger improvements to be made.

The present is a time of severe retrenchment. This retrenchment is being carried out on most railways in a desperate effort to effect the greatest possible economies and largely regardless of future consequences. With so many railway companies threatened with disaster it is difficult to find fault with any immediate saving that may be made, however effected, but the very existence of present conditions is the strongest argument for careful planning for the future. It is a notable fact that in general the railways on which the most careful planning has been done in the past and the greatest efforts made year by year to carry out the plans made are those on which today the smallest number of the costly maintenance-deferring retrenchments are now necessary.



S. L. Fhen and F. Y. Hie, two representatives of the Chinese government sent to this country to study telephone apparatus, were visitors at the Coliseum Tuesday evening, taking special interest in the railway telephone equipment exhibits.

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Judging from the frequency with which railway supply men are making trips to Cuba, the railways in that country must be in the market for tremendous quantities of material. Among those who have recently returned from business (?) trips to that island is F. L. Dodgson, consulting engineer of the General Railway Signal Company. Mr. Dodgson reports that the railway situation in Cuba looks very good.

* * *

W. P. Borland, chief, Bureau of Safety, Interstate Commerce Commission, came in on Tuesday to attend a meeting of the Joint Committee on Automatic Train Control. Mr. Borland left the following day with a subcommittee of the joint committee of the American Railway Association to make an inspection of the National Safety Appliance Company's intermittent induction type of train control which is in service on a short stretch of track on the Western Pacific.

* * *

One of the established customs of the convention is the assignment of Past President William McNabb to secure a prominent Canadian speaker at the annual dinner of the Association. The favor with which these speakers have been received by the Association is indicated by the fact that he has been requested to perform this duty year after year. Through his efforts the Association has been permitted to hear many of the most prominent men of Canada.

* * *

One of the interested visitors at the convention Wednesday was A. A. Potter, dean of engineering, Purdue University. Professor Potter is returning from a meeting of the Committee on Prime Movers of the National Electric Light Association, which committee has just completed an elaborate investigation, the results of which are contained in a 1,500-page report. Dean Potter has taken an unusual interest in the American Railway Engineering Association this year since the retiring president and the president-elect are both graduates of the College of Engineering at Purdue.

* * *

The memory of the late H. C. Cartlidge has recently been refreshed in the minds of many members of the American Railway Engineering Association through the receipt of copies of a bulletin of the International Railway Congress containing a review of the American railway practice in the use of concrete which Mr. Cartlidge prepared in 1914, but which was not published until again recently owning to the advent of the world war. A reading of this posthumous paper will impress one with the thorough grasp which this writer possessed in this branch of engineering in which he had played so important a part. This fact was recently driven home to G. A. Haggander, Mr. Cartlidge's successor as bridge engineer of the Chicago, Burlington & Quincy. Mr. Haggander has had occasion to study the paper published by the International Railway Congress very carefully owning to the fact that the congress requested him to prepare an addendum to Mr. Cartlidge's report with a view to bringing the subject up to date. Mr. Haggander has just transmitted this to the congress.

The Latest Ford Story

Railway men were interested some months ago to learn that the man who put the "tow" in auto and who has since endeavored to remake many of our established institutions had also taken unto himself a railroad for the purpose of showing railway men how railroads should be run. We have learned in the course of the last two days that this successful American citizen is determined to reform the traffic and operating departments of the railroad. Indeed, he has even decided to show something to construction and maintenance of way. Recently while riding his pet hobby (in a physical sense) he inquired of the officer who accompanied him why the right-of-way was so wide and after this had been explained to him he inquired what was the minimum width that would suffice for operation. On being advised that 20 ft. could be made to serve the purpose he said: "Fine, we will use the rest of it for factories." But this is not all. He has also shown the bridge engineers a thing or two. Recently when designs were submitted to him in connection with a proposed bridge renewal, it was found impossible to convince him that any of the designs would serve his purpose. He did not want a swing span, but the bascule design submitted to him contained too many superfluous features. The counterweights particularly met with his severe disapproval with the result that he insisted on a design in which the span is lifted with a beautifully simple device consisting of two stiff leg derricks with fall lines of sufficient capacity to lift up the ends without the aid of any of those superfluous features such as were embodied in the designs which ordinary mortals had prepared.

Dr. Gunsaulus Dies

Those who were present at the annual dinner Wednesday evening and noted the absence of Dr. Frank W. Gunsaulus who was on the program to deliver the invocation, were shocked to learn yesterday morning that he had died suddenly at his home during the night previous. In addition to being pastor of one of the largest churches in Chicago for a number of years, he had been president of Armour Institute of Technology, Chicago, since its creation over 20 years ago. Dr. Gunsaulus was known internationally as an engineering educator. He resigned his pastorate in 1919 in order that he might give his entire time to the development of an enlarged institute of technology.

Statistics on Employees and Compensation

WASHINGTON, D. C., March 17, 1921.

The Interstate Commerce Commission has issued its quarterly report of statistics on employees and compensation for the third quarter of 1920. These are the first statistics showing the effect of the wage award of the Railroad Labor Board last July. It reveals a total payroll for that quarter of $1,052,000,000 as compared with $801,000,000 for the previous quarter, an increase of 31 per cent. This pay roll consumed 62 per cent of the total earnings of employees. The number of employees averaged 2,158,000. The total payroll for the three quarters of 1920 aggregated $2,648,000,000.

An Interesting Type of a Double-Track Deck Girder Bridge on Steel Bents

Railway Engineering Association Proceedings

The Last Day's Session Included the Presentation of Reports by Nine Committees

IT WAS NOT UNTIL 4:30 yesterday afternoon that the twenty-second annual convention of the American Railway Engineering Association drew to a close with the installation of the officers elect for the coming year. Usually the discussion of the reports of the regular standing committees is completed by noon of the third day, but owing to the fact that the report of one committee was held over from the preceding day and discussion of some of the reports proved somewhat more lengthy than usual, the convention occupied nearly the entire afternoon. Abstracts of the reports and the discussions which followed are given below.

Report of Committee on Masonry

A final report on disintegration of concrete in sea water reviews the available data on this subject and presents recommendations covering the preparation of concrete for use in sea water which will be effective in preventing or minimizing the disintegrating tendencies. The effects of age and condition of storage on the strength of concrete are outlined in seven conclusions. Similarly the effect of low temperature on concrete is stated, giving references to leading authorities. The slump test and the float table, two means for testing the plasticity of concrete, are also presented as affording new measures for obtaining a better quality of concrete.

J. J. Yates
Chairman

J. J. Yates, chairman of the committee, is completing his second year in this capacity and has been a member of the committee since 1912. During this long period of service he has played an important part in the work, having served as the representative of the Association on a Joint Committee on Cement Specifications and is now vice-chairman of the New Joint Committee on Concrete and Reinforced Concrete. His position as bridge engineer of the Central Railroad of New Jersey makes him particularly valuable to the committee, owing to his experience with important concrete structures in the salt water of New York harbor.

THE WORK OF THE COMMITTEE has been largely confined to joint committee on standard specifications on concrete and reinforced concrete, on which a report is expected in 1921. In Appendix A the committee presented a report on the disintegration of concrete and corrosion of reinforcing materials in connection with the use of concrete in sea water. In Appendix B it submitted its report on the effect upon the strength and durability of concrete not having a sufficiency of moisture present throughout the period of hardening as compared with concrete fully supplied with moisture.

Conclusions

The committee recommended the following action be taken on its report:

That conclusions 1, 2, 3, 4, 5 and 6 as given in Appendix A be approved and substituted in the Manual for conclusions 1, 2, 3 and 4 as they appear on page 294 of the 1915 Manual under Disintegration of Concrete and Corrosion of Reinforcing Metal.

That the report as given in Appendix B be accepted and printed in the Proceedings as information.

Committee: J. J. Yates (C. R. R. of N. J.), chairman; Job Tuthill (P. M.), vice-chairman; J. T. Andrews (B. & O.), R. Armour (G. T.), G. E. Boyd (D. L. & W.), T. L. Condron (Cons. Engr.), L. N. Edwards (Bur. of Pub. Roads), J. E. Freeman, T. L. D. Hadwen, Geo. T. Hand (L. V.), W. K. Hatt (Purdue Univ.), L. J. Hotchkiss (Foundation Co.), S. C. Hollister, R. L. Humphrey (Cons. Engr.), Noah Johnson (Wabash), M. S. Ketchum (Univ. of Colo.), W. S. Lacher (Railway Age), A. E. Owen (C. R. R. of N. J.), W. M. Ray (B. & O.), F. E. Schall (L. V.), Z. H. Sikes (N. Y. C.), F. P.

Sisson (G. T.), L. L. Tallyn (D. L. & W.), C. C. Westfall (I. C.).

Appendix A—Disintegration of Concrete and Corrosion of Reinforcing Material

A great deal of attention has been given in the past to this subject, not only in America, but also in Europe and other countries. Many of the investigations published, however, are based upon laboratory tests, which, while very interesting and valuable, do not furnish all the facts as to the action of sea water on concrete. Concrete placed in sea water is not only subject to a chemical action taking place in the transformation of some of the elements composing the concrete, but more particularly to the mechanical attacks due to the action of the tides, waves, ice, drift or accident, the variation of temperature, especially in the colder latitudes, all tending to injure the film of the exposed surface. When this film is once pierced or abraded, the aggregates and binding material offering less resistance, are exposed to these attacks, causing the more or less rapid destruction and failure of the concrete.

Engineering publications in the past record many failures of concrete placed in sea water; the causes are variously ascribed to the chemical effect of sea water on concrete, to the mechanical action of the tides and waves (largely aggravated in Northern latitudes by alternate freezing and thawing between high and low water level), poor selection of aggregates or lack of proper workmanship, etc.

Whether such failures were due to any one of the causes mentioned or to their combined action cannot be answered directly. It is known, however, that in the development of the various methods of proportioning, mixing and depositing of concrete during the past few years, much has been accomplished to make a concrete that will better serve the general requirements of good concrete construction. With proper study of all the conditions encountered in a particular piece of work, and with first-class material and workmanship, it is thought possible that concrete may be made that will withstand the action of sea water in warm climates, if guarded against abrasion, and by providing special face protection against the action of frost or floating objects, between low and high water, concrete may also withstand sea water in the colder climates.

Plain Concrete in Sea Water

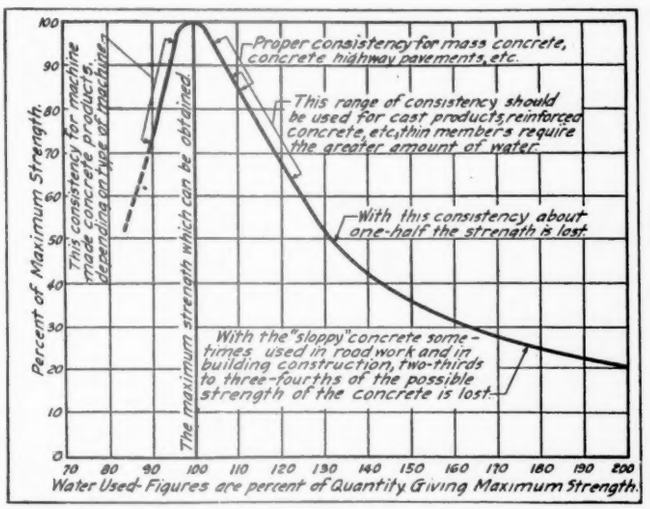
For concrete structures in sea water particular attention is to be given to designing, to the avoidance of all sharp corners, offsets or pockets tending to obstruct the flow or gliding of waves and floating objects past the structure. The cement used in this class of work to be Portland cement, which must meet the requirements of the current specifications of the American Railway Engineering Association.

In the proportioning of fine and coarse aggregates, it is most important that a highly dense, impervious product be obtained. It is recommended that thorough tests be made to establish that mix which will result, with the aggregates used, in securing the greatest density of the concrete, and to continue these tests to maintain the proper mix at all times, until the completion of the work. Allowance should be made for the loss of cement when concrete is deposited into sea water. Special attention must be given to exposed surfaces to secure a hard, even and non-porous face of concrete. For pre-cast concrete blocks, piles, etc., placed in sea water, the foregoing requirements are equally important. Better results have generally been obtained heretofore with pre-cast blocks than with concrete deposited into sea water, but the blocks must be well seasoned before being placed in position.

The sand must be free from clay or other foreign matter; clean, well-graded fine to coarse sand will produce the best results. The coarse aggregate should be carefully selected. It must be uniformly hard and durable. Non-porous, screened washed gravel is preferable for sea water work, especially in colder climates, although sound, hard, crushed stone may be used. Gravel affords better mixing and it settles more easily into place. Bank-run gravel, however, should not be used, since generally its quality is not uniform. Sea water has been used in the gaging of concrete, and it was found that the strength of the concrete is affected only to a small extent. Fresh water should be used when such can be obtained without unreasonable expense.

The gaging of the concrete is of great importance; the consistency should neither be too dry nor too wet. If deposited in air, a consistency that permits of light tamping and packing to bring water to the surface without much effort will generally be best; rodding, to secure greater density, may be employed to good advantage.

The time of mixing of the concrete for sea water construction must receive special attention, and should be tested out with the particular mix used, so that all particles of the fine and coarse aggregates are thoroughly coated and the full strength of the cement used obtained. It is an established fact that the strength of the concrete increases, according to the time allowed for mixing, up to a certain point, and full advantage should be taken of this element; two minutes is considered a minimum.



Effect of Quantity of Mixing Water on the Strength of Concrete

In depositing concrete into sea water, continuous operations must be employed and the greatest care exercised if failure is to be avoided, either using a well-designed watertight tremie or a bottom drop bucket. It is important that the concrete be deposited systematically. If a tremie is used, it must be kept filled at all times; when a charge is lost, the tremie must be withdrawn and refilled. If a drop bucket is used, the concrete is to be discharged from the bucket alongside the last previously placed; the whole of the surface should be kept as level as possible. In all cases, enclosed cofferdams should be used to prevent washing. In case of unavoidable interruption of the work, it is most important that the top surface be thoroughly cleaned of laitance after the stoppage of work before additional concrete is placed. The concrete above the low water line should be tamped and

compacted as it is placed and thoroughly worked next to the forms, to obtain a dense, smooth, non-porous surface.

If the foregoing is followed, a good and lasting plain concrete should be obtained, but this is only possible by constant vigilance, rigid supervision and care, in every detail of the process of construction. The least infraction on the established proportions or laxity in thorough workmanship may lead to failure.

Reinforced Concrete in Sea Water

The protection of reinforcing steel in concrete placed in sea water is dependent upon the density, impermeability and lasting qualities of the concrete in which it is embedded, and the distance of the reinforcing steel from the surface of the concrete. When the surface film of the concrete is once abraded by mechanical or other action, the reinforcement may be reached by the sea water either through capillary attraction or exposure of the metal. The steel will then rust, causing its destruction, and also the spalling of the concrete by reason of the enlargement of the rusted steel. It is, therefore, imperative to construct a dense, impermeable concrete when steel reinforcement is employed.

Where possible, mass construction should be adopted for such part of concrete structures as will come in contact with sea water, between high and low water, and even for the parts above the high water line, steel reinforcement should be so placed that there is at least three inches dense concrete between the surface of concrete and the face of the steel to prevent moisture from the salt air penetrating to the metal.

Conclusions

1. Concrete for sea water work should be mixed in the proportions of one part Portland cement to not more than six parts of fine and coarse aggregates, measured separately and combined in such proportions as will produce a concrete of maximum density and impermeability. Only enough water should be added to secure plastic workability. The concrete shall be mixed in a batch mixer for not less than two minutes after all the materials are in the drum. Where concrete is deposited into sea water, the above proportions should be reduced to one part of cement to not more than five parts of separately measured aggregates. Tests should be made from time to time during the progress of the work to maintain the proper proportions of the aggregates throughout construction.

2. Concrete should be deposited in the air wherever practicable. When necessary to deposit concrete in water, it should be protected from currents by cofferdams or similar means.

3. The concrete, where practicable, should be deposited in a continuous operation to a point five feet above high water. In case of unavoidable stoppage of the work, the previously cast concrete should be thoroughly cleaned of all laitance.

4. From two feet below low water to two feet above high water, or from a plane below to a plane above wave action, the face of the concrete should be adequately protected against mechanical abrasion and frost action. Construction or other joints should in every case be avoided within this zone. Sharp corners and projections should also be avoided, but where necessary they should be rounded to reduce abrasion to a minimum.

5. If reinforcement is used in concrete in sea water, special attention should be given in the design to the position of the reinforcement. In no case should the steel be nearer than three inches to any plain or curved surface, and not less than four inches from any two adjacent surfaces.

6. The most rigid rules in regard to workmanship and inspection should be established and constantly enforced on all sea water work.

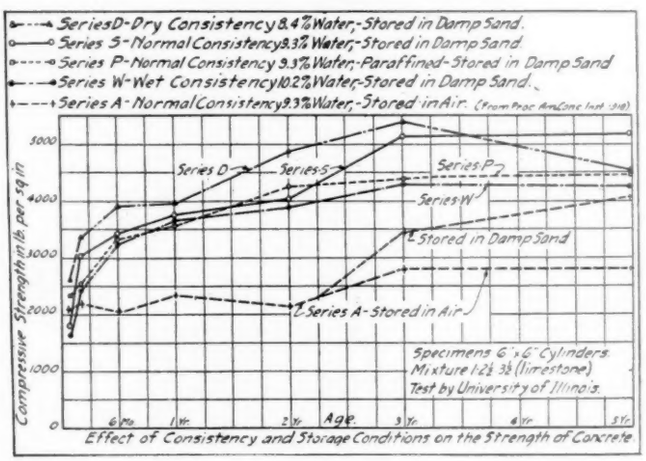
Appendix B—The Effect Upon the Strength and Durability of Concrete

A series of tests have been made at the University of Illinois supplemented by investigations made by the Chicago, Burlington & Quincy to determine the effect of age and condition of storage upon the strength of concrete. The results of the tests have been summarized as follows:

"1. The strength of the concrete which was stored in contact with moisture increased rapidly up to an age of one year; the increase in strength at ages greater than one year, although considerable, took place at a much less rapid rate.

2. The air-stored concrete attained nearly its final strength at a comparatively early age and gained little strength with the lapse of time.

3. The concrete which had been stored in air for a considerable time increased in strength greatly after it had been stored in contact with moisture, so that further hydration of the cement could take place; the strength of the specimens stored in damp sand two years and eight months after they were two years and four months old was 1.46 times the strength of the specimens which remained stored in air for five years.



Effect of Age on Compressive Strength of Concrete

4. The strength of the concrete at an age of seven days for both damp sand storage and air storage was about 70 per cent of the strength at 28 days; at an age of one year the strength of the concrete stored in damp sand was about twice as strong as at 28 days and the air-stored concrete was only 10 per cent stronger than at 28 days. At an age of five years the strength of the concrete stored in damp sand was about 2.5 times the strength at 28 days and the strength of the air-stored concrete about 1.3 times the strength at 28 days.

5. At ages of three and five years the strength of the concrete stored in damp sand was about 1.9 times the strength of the air-stored concrete.

6. For the specimens stored in air the strength at an age of eight years was slightly more than that at six months.

7. The strength of the specimens stored in water for 10 months after they were seven years old was 1.3 times

the strength of the specimens which remained stored in air for eight years.

It seems apparent that concrete in structures exposed to air which is not damp will gain little strength beyond that attained at the earlier ages, in the portions where loss of moisture takes place, while concrete in contact with moisture or dampness will continue to gain in strength for some years."

Discussion

J. J. Yates (Chairman): The work of the Masonry committee this year has been largely confined to the work of the Joint Committee on Specifications on Concrete and Reinforced Concrete, and many of its reports are deferred pending the results of the final specification that is to be issued by that committee. I am pleased to announce that in accordance with the instructions of the joint committee, it is proposed to issue a tentative specification to the societies represented on the joint committee about May of this year, and I understand it will probably be published in July in our Bulletin. Under the rules of organization that discussion is to be open one year, and then it goes back to the joint committee for further consideration and preparation of the final specification.

The committee reports on two subjects, one a progress report, and one for insertion in the Manual. The first report for insertion in the Manual is report on disintegration of concrete and corrosion of reinforcing materials in connection with the use of concrete in sea water. This subject has been before the committee for several years and there have been several progress reports made. I will ask Mr. Schall, chairman of the sub-committee, to present the report.

F. E. Schall (L. V.): In presenting this report of sub-committee 2 of the Masonry committee it is well to state that we have found it difficult to find a common ground on account of the diversity of results obtained in using concrete in sea water. Ordinary concrete today used in sea water will not perform its duty. It requires the most careful attention in preparing the aggregates, grading them to the proper sizes, the mixing of the concrete, the placing of the concrete and working it in place, so as to obtain a dense impermeable product. The report has been published so there is no reason to go any further in regard to this matter, but I will read the conclusions.

(Mr. Schall read the conclusions.)

(*Moved that they be adopted by the Association and published in the Manual, and the motion was carried.*)

Chairman Yates: The next subject we want to present as information and we would like to have discussion. It is a very important subject, that is, the amount of consistency of concrete, and I am going to ask Mr. Freeman to discuss this.

J. E. Freeman (Port. Cement Assn.): The effect of the quantity of mixing water upon the strength and other properties of the concrete is a matter which has been brought out most forcibly by recent investigations. A chart shown ilustrates the effect upon the strength, showing how, as the quantity of water increases, so the strength of the concrete that is produced decreases. In many cases in ordinary construction, the quantity of water that is used today is probably anywhere from 30 to 50 per cent in excess of the quantity needed for maximum strength. Now, of course, it is true that a concrete giving the maximum strength indicated on the chart would be rather too stiff to work readily in placing the concrete in structures, but at the same time a great deal can be done towards decreasing the quantity of water, and still have a plastic workable mixture that can be placed in forms without extra effort. By cutting down on the amount of water, which would bring up the strength along the curve to a point between 110 and say 125, the strength of the concrete can be realized, which will be 70 to 90 per cent of that possible. The use of an excess quantity of water is bad from two standpoints. In one case it means waste of good material, and in another case it means a reduced factor of safety in the concrete that goes into the work. The excess water also means that other properties of the concrete are reduced in somewhat like proportion.

However, it is possible to control the quantity of water by means of a simple test which has been developed, called the slump test. The slump test can be used as a means of determining the slump of concrete that is produced with a given consistency, which has been selected on the basis of the mixture selected for work and the aggregates that are used as being the proper consistency for that particular class of work. This, then, can be transferred to the job and used as a control test for the maximum slump permissible. It is not necessarily an exact test. At the same time it is a good check to see that the consistency which has been selected for that particular job is not being exceeded by the use of more water than is really necessary.

A report which was presented in connection with the Masonry committee report for 1919 showed the results of some tests on the effect of moisture applied to the concrete while hardening and upon the compressive strength and the resistance to compression. Some of the tests now presented with this report as information carry this on further, covering a period from one year to seven years.

A. F. Robinson (A. T. & S. F.): I am one of the unfortunates who is not willing to accept the so-called slump test. It may be all right, and it doubtless is, but it is like some of those peculiar things which we can make mean almost anything. I feel a good deal as though the investigations thus far made, and while they were made on proper lines, have at the present time resulted in clouding the results. It does not seem to me that we ought to arrange our rules for making concrete in such a way that we have got to have a so-called concrete expert on every division of the road. We ought to be able to make our rules so that they are very clear and simple, and so that we can put them into the hands of any intelligent gang foreman and have the work carried out properly and get fine results.

I feel further that insufficient attention has been given to the question of the time the mixer is running. There is another very important feature, which does not seem to me the committee has even touched on, and that is the care of the concrete after it is placed. In this section of the country and east of here, there is usually a sufficient amount of moisture in the atmosphere to cure the concrete, but when you go west, we will say north and south of the line through Dodge City, every 10 miles you go west the quantity of moisture in the atmosphere is reduced, and I doubt if more than 70 per cent of the concrete that is built west of that line is anywhere near so good as it ought to be. This feature is one of the troublesome ones that I have to contend with. I am trying to find a method by which when concrete h s been placed and the forms removed, we can coat it with something that is going to hold all of the moisture that has been put in the concrete in the mixing, and permit a complete hydration of the cement.

I have had several unfortunate cases in hand where we had failures of reinforced concrete girders. We have cut out pieces of the concrete that would break like a piece of half-dried clay. Afterwards these samples were put into water and left there for a week and we got a

fine ring to the pieces. In other words, the hydration of the cement was again started, even after it had stopped for several years.

Please do not understand from my remarks that I am attempting to ridicule or belittle this slump test and the test submitted by the Bureau of Standards. That is not my purpose. I am with you heart and soul in every kind of an investigation that can produce better concrete.

Chairman Yates: As to the mixing time, there has been considerable investigation on that point. I agree with Mr. Robinson there is a good deal of trouble now, and we hope to join with the Concrete Institute this coming year in investigations of mixers. We do not know enough about mixers.

As for the care of concrete after seasoning, we had some reports last year but they were not satisfactory. We are not satisfied with the information we have for the Joint committee, and if any of the members have information with regard to failures of concrete and will send a written discussion on the subject, we will be only too pleased to put it before the committee.

(The committee was excused with thanks.)

Report of Committee on Buildings

A report on the classification of buildings for purposes of ascertaining the approximate cost of new construction shows that while detailed estimates are the most satisfactory, the amount of work entailed is too great where a number of structures are involved. Pricing curves are established by plotting known costs of actual building construction, using total cubical contents and the cost per cubic foot of a number of structures of one type. Sixteen separate classifications are submitted for the proposed final specifications of buildings. Results of studies presented in proposed specifications covering the first eight classifications.

W. T. Dorrance
Chairman

W. T. Dorrance, who is completing his first year as chairman, has been a member of the committee since 1915 and in this connection has participated in the extensive and constructive work which it has done in this period. The studies of this committee have done much to promote standardization of design and construction of the smaller railway buildings and have contributed thereby to economy of operation. The report this year is an important contribution to the knowledge of building classification. Mr. Dorrance is designing engineer of the New York, New Haven & Hartford and as such is brought into intimate contact with intensive maintenance problems.

In Appendix A the committee submitted their report on the classification of buildings. In regard to specifications for buildings, specifications and methods in use were secured from various railroads covering various sections of this country and Canada. Careful study of the subject was made and decision reached that it was advisable to prepare separate specifications on the loose-leaf principle covering each class of work entering into railroad buildings. This would enable selecting the specifications required for any building desired and binding together to form a specification for that building. The subjects for these separate specifications are covered by the following list:

(1) General conditions (to be attached to all specifications); (2) excavation, filling and back fill; (3) sewers and drains; (4) concrete; (5) brick work; (6) carpentry and millwork; (7) lathing and plastering; (8) hardware; (9) painting and glazing; (10) roofing; (11) plumbing; (12) lighting; (13) heating (steam); (14) heating (hot water); (15) heating (hot air); (16) scope of the work—In addition to the above specifications for the various trades, a specification should be drawn for each job defining definitely the scope of the work.

Eight of these were completed and presented as Appendix B.

The committee felt that it was practically impossible to write a specification that could be used without change by every railroad, but that the specifications submitted could be used as a guide, each road making slight modifications to fit local conditions.

Committee: W. T. Dorrance (N. Y. N. H. & H.), chairman; J. W. Orrock, (C. P. R.), vice-chairman; F. L. Beal (St. L.-S. W.); G. A. Belden (C of G.); Eli Christiansen; D. R. Collin (architect); W. H. Cookman (Penna.); A. Crable (H. V.); W. L. Darden (S. A. L.); K. B. Duncan (A. T. & S. F.); J. B. Gaut (G. T.); A. M. Griffin (A. C. L.); F. F. Harrington (Vir.); F. R. Judd (I. C.); G. A. Mitchell (G. T.); R. V. Reamer (C. R. R. of N. J.); C. W. Richey (Penna.); G. A. Rodman (N. Y. N. H. & H.).

Appendix A—Classification of Buildings and Methods for Ascertaining Approximate Cost

The subject assigned to the committee indicates that only a method be outlined and that no attempt be made to establish costs due to varying prices of labor and material, and differences in types of construction. The report included three different methods for estimating as follows: (A) Bill of particulars method; (B) square foot method, and (C) cubic foot method.

The Bill of Particulars Method

The "Bill of Particulars" method calls for simply a detailed estimate as is now the common practice of engineers and contractors for arriving at cost of construction. This is the most accurate and is perhaps the most satisfactory method which can be devised where only one or a very few buildings are to be estimated. Where there are a number of structures similar in type the burden of making so many detailed estimates would be large and it is advisable to use some short cut of reasonable accuracy.

The Square Foot Method

The "Square Foot" method necessitates first making up a series of bill of material estimates or applying known costs of existing buildings on the various types of buildings selected, and plotting these estimates and costs so that curves can be drawn establishing a square foot price. The application of it is very approximate due to the fact that buildings of the same type will vary in height and other particulars, but the "Square Foot" method is satisfactory for approximate estimates.

The Cubic Foot Method

The "Cubic Foot" method must also be built up by first making bill of material estimates or plotting known costs

and establishing a price per cubic foot in the same way for the various types of buildings selected. The application of this method is more accurate, as it takes into account the different heights of buildings, varying cubage of roof construction, etc. The following method, which is based on specification type, is by no means perfect and is not the only one that can be used, but it has been used satisfactorily on a number of railroads in connection with government valuation with various modifications. Briefly the method is as follows:

First, set up certain types of buildings, based on specifications, separating the different types of construction and different utilities, giving for each type a specification sheet showing briefly the principal details of construction. It is advantageous to make as few types as possible, consistent with local conditions. Each type may cover the complete structure, including normal foundation, plumbing, heating and lighting, but for accurate results it is recommended that the building type cover only the shell, setting up the foundation as a separate type and adding plumbing, heating and lighting at a cost per unit.

Following this latter scheme, there would first be set up type standards to cover the following foundations—the type description to show the depth, general dimensions, class of masonry, etc., as follows:

(1) Timber post, 8 in. x 8 in.—5 ft. C-C, 7 ft. long.
(2) Masonry pier, 12 in. x 12 in., brick on concrete footings.
(3) Trench walls, 20 in., rubble or concrete walls.
(4) Trench walls, 30 in., rubble or concrete walls.
(5) Cellar, 20 in., rubble or concrete walls, with 12 in. x 30 in. footing concrete floor; 1 flight plank stairs; coal bin—windows with areas and gratings.

The following types for superstructure are suggested and will probably answer the purpose on most roads:

Frame passenger station	3 types
Brick passenger station	3 types
Stone passenger station	1 type
Concrete passenger station	1 type
Frame freight house	3 types
Brick freight house	3 types
Concrete freight house	1 type
Frame shop, 1 and 2 story	2 types
Brick shop, 1 and 2 story	2 types
Frame engine house	1 type
Brick engine house	1 type
Concrete engine house	1 type
Frame section house	2 types
Frame yard buildings	3 types
Signal towers	4 types
Dwellings	5 types
Office buildings	3 types

The above schedule of types is suggested for use in connection with valuation of existing buildings. For new work it would probably be advisable for any one road to limit the number of types to a minimum.

Each superstructure type should show the kind and style of framing, size of principal members, description of flooring, wall covering ceiling, outside covering, roof, over-hang chimneys, and other building items, as per specimen type sheet as follows:

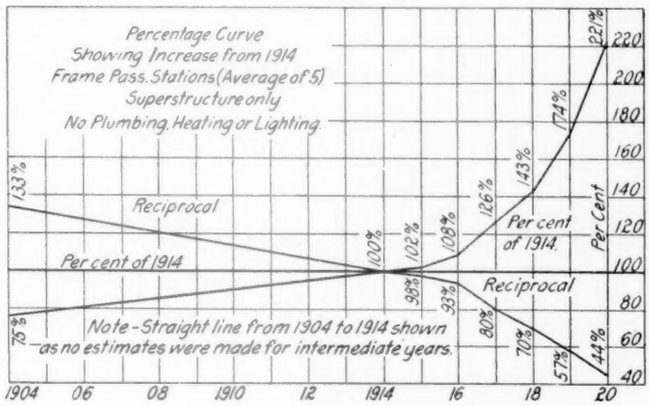
Specification for Building of Type No. 1

FRAME PASSENGER STATION—TYPE NO. 1

Frame: Spruce sills, 6x8 in. Floor joist, 3x10—16 in. C-C. Posts, 4x6 in. Studs, 2x6 in. C-C. Plate, 4x6 in. Rafters, 2x10—20 in. C-C..
Framing: Full mortise and tenon.
Exterior Walls: Sheathed and clapboarded with paper between (or covered with wood shingles or tin shingles).
Exterior Trim: Cypress, corner boards, water table, belt course, facia and cornice.
Interior Walls: No. 1 planed, matched and beaded Nor. Car. pine sheathing with wainscot 3 ft. 6 in. high.
Ceiling: No. 1 planed, matched and beaded Nor. Car. pine (or 2 coats plaster).
Floors: 1 in. Rift hd. pine on 1 in. under floor.
Interior Trim: Cypress, all stock shapes.
Roof: 1 in. boarding with building paper, tin, wood or asphalt shingles.
Gutter: Wood or galvanized iron.
Conduction and Flashings: Galvanized iron.
Overhang: 6 ft. wide on four sides, sheathed underneath, with brackets.
Doors and Windows: All stock shapes and sizes.
Hardware: Iron, bronzed finish or brass.
Painting: 3 coats lead and oil. Inside filled and varnished.
Interior Fittings: 1 ticket shelf, 1 telegraph shelf, 200 ft. b.m. of pine shelving; iron wire grill in ticket window.
Chimney: Two 4 in. brick walls, 8x12 in. flue lining. Additions should be made for slate or tile roof, concrete or terrazzo floor, special sizes and shapes of doors and windows, fireplace or mantel of elaborate design.
Plumbing: Various types should be set up to cover the principal classes of fixtures used by the carrier, and a price per fixture estimated for each type. This price is to include the proportional part of the total cost of such items as sewer and water connections, meters, soil pipe, etc. The following types for plumbing fixtures will answer most purposes:

Closet with wood stall complete.
Closet with slate stall complete.
Urinal, flat back.
Urinal, with slate stall.
Urinal, full porcelain stall.
Wash bowl.
Sink, 18 in. x. 30 in., cast iron with back, legs and fittings.

Heating: The best method of typing and pricing heating systems is on the basis of cubic foot of space heated—the system to be complete in itself, including boiler, radiators, and piping. Type to be set up to cover the following units:



Trend Curve for Building Costs

Hot air furnace.
Steam—One- or two-pipe system. Cast iron radiators.
Steam—One or two-pipe systems. Pipe coils.
Hot water—Two-pipe system. Cast iron radiators.
Hot water—Two-pipe system. Pipe coils.

Lighting: This can be computed on either a cubic foot basis or price per fixture, but from experience we believe that the price per fixture is most accurate and easiest to apply. The price per fixture to include connection with city lines, meters, switches, and all wiring and fixtures inside the buildings, throwing everything into a type with the exception of very elaborate or expensive fixtures which should be priced separately. The following types are suggested:

Electric lights with wall brackets—plug or drop.
Electric light with chandelier, 2 to 4 lights.
Gas—wall brackets.
Gas—chandelier, 2 to 4 lights.

Furniture: The furniture in a building usually varies considerably even in buildings of the same general type, and we believe that a better method is to make a complete inventory and price each article separately, although such buildings as section houses and small railroad stations can be handled by assigning a typical outfit and putting one lump sum price on the whole outfit.

After setting up these various types, pricing curves should be plotted to cover foundation and superstructure, using the left-hand margin for the actual cubic contents of the building and the top and bottom margins for the price per cubic foot.

In order to establish the curve for any particular date, several structures conforming to the type are selected—taking the largest, the smallest and several intermediate sizes—a complete bill of material estimated and priced, and from this is computed the total estimated cost of the shell, and the cost per cubic foot. These points are plot-

ted on the sheet and in addition all available contract costs and costs of structures built by company forces, which conform to this type, also plotted. With these various points an average curve is drawn. These curves can be used for either pricing buildings for valuation purposes or for estimating the cost of new work, as of the one given date. Due to the rapidly changing labor and material prices, some method must be devised for modifying cost figures so that comparison can be made between similar types built at different dates. This can be done by a curve showing the cost of construction from 1904 to 1920, taking 1914 as normal and plotting the average for each year.

It is found that the pricing curves for the various types of buildings all follow the safe general shape and after establishing the form of the curve it is only necessary to figure about three buildings of any one type in order to give the curve the proper location on the pricing sheet. The method of applying this scheme in practice is to figure the cubic contents of the building—pick up the price per cubic foot from the curve sheet, and apply it to the cubage. In the same way figure the cost of foundation, then add the number of units of plumbing, heating and lighting at the type price, add such items as furniture, grading, outside drainage, platforms, etc.

Discussion

W. T. Dorrance (Chairman): The subjects assigned to the Committee on Buildings this year were five. (Read subjects.) A study of the Manual was made and the committee has no recommendations to make involving the subject matter; the conclusion on this subject merely refers to the editing and rearrangement of the subject matter now published.

Chairman Dorrance: Subject No. 2 on the Classification of Buildings was given considerable study, and the committee presents as information the matter contained in Appendix A.

Chairman Dorrance: Subject No. 5 is to report on specifications for buildings for railroad purposes. The committee secured specifications from various railroads and made a careful study and analysis of the ones they were able to secure and from the data and information collected felt that the proper form for a general specification of this sort was in what might be termed the loose leaf form, whereby each general subject was given a specification by itself, so as to make possible the combining of any number of these into one specification for such buildings as might be under discussion. We selected 16 different subjects and were able to prepare specifications for 8 of these. The committee would like to have the approval of the Association for this general method of the work and would like to submit the 8 specifications which we have prepared for discussion, expecting them to lay over for a year before they are offered as final conclusions for insertion in the Manual.

O. E. Selby (C. C. C. & St. L.): I notice that carpentry and millwork are associated together. I have found that the practice in actual work is to separate these two subjects distinctly, the millwork is sublet usually and is a distinct classification. The carpentry work includes rough lumber and the placing of the mill work. The mill work includes all work that is dressed or framed in the mill before going to the site, and I think it will facilitate letting mill contracts if these two subjects are specified separately, and it can then be shown distinctly in the case of each building just what is included in the term mill work.

(The committee was excused with the thanks of the Association.)

Report of the Committee on Roadway

Some subsidence occurs under all embankments built on any ground except rock, the percentage being greater under small fills than under large ones. No fixed rule is possible for estimating the amount. Tests show that an average allowance of 10 per cent will cover shrinkage on earth removed from excavation. Local conditions must be studied in ascertaining subsidence or swell in rock. More consideration should be given drainage conditions when contemplating construction of long cuts on flat grades. Where such cuts are unavoidable good, wide, deep side ditches should be provided. If impracticable, subdrainage should be provided.

J. R. W. Ambrose
Chairman

J. R. W. Ambrose has served as chairman for two years and as a member of the committee for eleven years. He has given much time to the work of the committee and has studied at length the problem of determining unit pressures allowable on roadbeds of different materials. He served as chairman of a sub-committee investigating this subject at one time, working in co-operation with the Committee on Stresses in Railroad Track. He is chief engineer of the Toronto Terminal Railway Co., a joint organization of the Canadian Pacific and the Canadian National which has under way the reconstruction of the terminals in Toronto.

THE COMMITTEE submitted (1) a few proposed changes and revisions of the definitions in the Manual. It also presented its findings and recommendations in regard to subjects (2-3) subsidence and shrinkage, in Appendix B; (4) metal culverts, in Appendix C; (5) sealing of cracks by cement gun, in Appendix D; and (7) drainage of long cuts. Progress reports were made on (5) sealing of cracks by cement gun and (6) standing water in borrow pits.

Conclusions

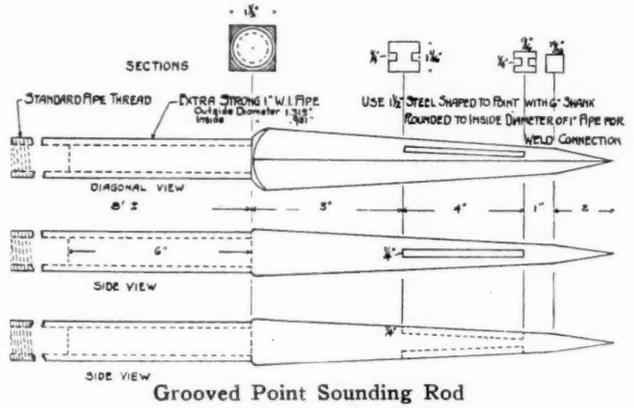
The committee recommended that the findings and conclusions on subjects 1, 2, 3 and 7 be adopted and placed in the Manual and those on 4, 5 and 6 be accepted as information only and incorporated in the proceedings.

Committee: J. R. W. Ambrose (Tor. Term.), chairman; J. A. Spielmann (B. & O.), vice-chairman; E. J. Bayer (C. C. C. & St. L.), C. W. Brown (L. & N. E.), H. W. Brown (Penna.), C. C. Cunningham (C. R. I. & P.), W. C. Curd (Cons. Engr.), W. M. Dawley (Erie), Paul Didier (B. & O.), S. B. Fisher (M. K. & T.), R. D. Garner (S. N. E.), J. A. Lahmer (M. P.), J. G. Little (Railway Age), H. W. McLeod (C. P. R.), C. M. McVay (K. & M.), W. H. Penfield (C. M. & St. P.), P. Petri (B. & O.), J. W. Pfau (N. Y. C.), Frank Ringer (M. K. & T.), R. B. Robinson (U. P.), R. A. Rutledge (A. T. & S. F.), H. E. Tyrrell (Sou.), C. E. Weaver (L. I.), W. H. Woodbury (D. M. & N.).

Appendix B—Subsidence and Shrinkage of Embankments

Subsidence occurs principally and to the greatest extent in marshes, swamps, bogs and wet lands, the reason obviously being that the natural ground will not sustain the combined embankment, track and loads. In many cases the yardage below the original natural surface of the ground was found to be several times the quantity of that above it. In preliminary work there is no fixed rule for determining what amount of subsidence will occur. The engineer locating a new or additional line through bogs, swamps, marshes, etc., would do well to make allowance for considerable subsidence. In some cases, before building, soundings have been taken with a view to locating the hard surface under swamps, bogs, etc., and allowance made for the fill to subside to that level. This is not always possible, however, and it sometimes happens that this hard surface will break under the weight and subsidence continue indefinitely.

It was found that subsidence to some extent will invariably occur under embankments built through ordinary grazing or agricultural land. This applies to the greater percentage of embankments, as most of the land in the country comes under this class. This is due to the loose formation of the upper crust of the ground, which has not



Grooved Point Sounding Rod

the bond, weight or density of the lower beds due to the roots of grass and other vegetation, plowing and the action of frost keeping the bond continually broken up. The percentage of subsidence will be much greater on the small fills by reason of the smaller area of the base and the tamping action of trains. On the larger and higher fills the base is spread over a much greater area and the tamping action is not so pronounced at the base, consequently the subsidence is proportionately less.

The committee called attention to the good results secured in determining the extent of subsidence on small fills by means of a slotted and pointed bar, which, when driven to the bottom of a fill and turned leaves in the slot a specimen of the material at that point. For convenience of handling an extension may be put on the bar. This method, however, would not be practical on fills of over 10 ft. Great care should be taken in recording the measurements of the different depths.

Trenching is the most accurate method of determining subsidence. It is not, however, always practicable or possible to trench, in which case the boring methods must be used. Wash borings are more or less inaccurate and should be used with care. Several roads report they are unable to get any real results from their use, the holes filling with soupy, muddy water and the dividing lines of the strata impossible to determine. Dry borings protected by casing, if necessary, have given good results when proper care has been taken in making and recording same. In determining the extent of subsidence, care should also be taken in locating the line of the natural surface at the toe of the embankment. On account of the earth often sliding or washing down and spreading out at the toe, a very gentle slope is left, which can easily be mistaken for the natural surface.

Subsidence occurs in two distinct ways. By compression and by displacement. On ordinary land the upper strata of earth being weakly bonded will tamp and compress, permitting the fill to subside. This will also occur in shallow swamps, such as muskeg, or where water standing on the ground will lessen its bearing power. Subsidence from this cause, as a rule, is not serious from an operating standpoint, as it will cease after the strata of soft material immediately under the fill is sufficiently compressed or tamped. Great and serious subsidence is caused by displacement. In deep, bottomless bogs and swamps, the embankment often continues to subside, displacing large quantities at the sides and requiring constant attention to prevent the interruption of traffic. In some such cases embankments have been known to reach a state of equilibrium without having reached a solid bottom, but this has taken a considerable time. Others are still subsiding after many remedies have been tried, and it seems probable will continue to do so indefinitely.

The effect of subsidence is to lower the base of the fill, causing a corresponding shrinkage of the track structure, involving heavy maintenance charges, and in some cases so large as to justify the abandonment and relocation of the line.

Conclusions

Some subsidence occurs under all embankments built on any ground except rock. It is very light in sand and gravel. The percentage of subsidence is greater under small fills than under larger ones.

Subsidence is due to compression or displacement of the strata of earth under the embankment.

Subsidence must always be anticipated in swamps, marshes and bogs, and any land on which there is standing water.

Serious subsidence is local and it is impossible to fix any rule as a guide in estimating or anticipating same.

The question has been raised as to whether shrinkage actually exists. It is felt by the committee that the existence of shrinkage is proved by every ditch or sewer line and every post hole. The Chicago, Burlington & Quincy, Duluth, Missabe & Northern and Duluth & Iron Range have made shrinkage tests by the density method, which may be briefly described as follows: Samples are taken from various points in embankments with an iron or steel cylinder of known cubical capacity, care being taken to neither compress nor expand the material. The same thing was done in adjacent excavation when it was quite certain that the embankment was built from this excavation. These samples were taken to the laboratory, where they were weighed and placed in a dry, warm or hot place. When samples were quite dry they were again weighed. The differences in weight is taken as measurement of change in volume. This method was described in detail on page 1573 of the June 4, 1920, issue of the *Railway Age*.

The results obtained indicate that the experiments should be carried on more extensively. Some remarkable ideas are developed, such as that the shrinkage of material is proportional to its weight, and weight depends on the depth in the natural bed. These subjects are capable of great and interesting development. From the results as obtained by this method it would seem the net shrinkage (making no allowance for subsidence) of common earth, would average close to 9.5 per cent and as 10 per cent is the commonly used allowance this would show it to be

approximately correct. The experiments prove that shrinkage does exist.

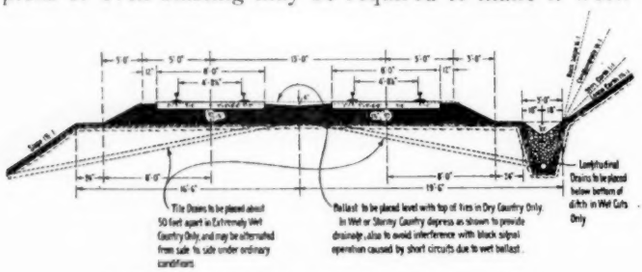
Shrinkage is composed of four elements:

(a) Wastage due to loss in hauling material from cut or pit to embankment. This is usually very small and may be neglected.

(b) Wastage due to wind erosion. This is an element which varies with the climate and nature of material. The exact percentages are practically impossible of determination.

(c) Wastage due to water erosion. This is a large factor and very difficult of exact determination, except where large washouts have occurred. It varies with climate, but often is quite as large in dry climates, which have sudden freshets, as in wet climates where there is an almost continuous water erosion.

(d) Compression, which is by far the most important cause of shrinkage. The condition of the material in its natural bed is usually the result of sedimentation in water and generally the particles are not compactly assembled, but are slightly cemented and thus have a temper that may be very hard to break up. Heavy plowing, picks or even blasting may be required to make it work-



A General Plan for Very Wet Locations

able. After this cementaceous bond is broken up the particles will settle together much more compactly, particularly if mechanical means are used to compact them, such as the trampling and rolling caused by teams, wagons, slip or wheel scrapers and later by the pounding of locomotives and cars. This water tamping will produce a similar compacting to a large extent. This water tamping is sometimes artificially applied, but usually rains furnish the water, and the railway traffic, during both wet and dry weather, brings about a combination of water and mechanical tamping. The result is a very great shrinkage. Settlement, as used herein, may include three elements, which are shrinkage, subsidence and a reduction in height and volume that is neither. Settlement is the decrease in height or volume, or both, of an embankment or the bed of a cut from the moment of construction, until it becomes stable. Subsidence is an element of settlement and may be defined as the result of a downward movement of embankment or ballast material below the natural surface line. Subsidence causes a compression downward or a displacement horizontally of the underlying material. It may be either under embankments or in cuts. Settlement may occur without there being either shrinkage or subsidence, but there can be no shrinkage or subsidence, as herein defined, without settlement.

From the information received by the committee, it is found that an allowance of 10 per cent for shrinkage of earth is almost universal and is generally very nearly correct. In practically all cases this is assumed to also cover the slight subsidence which will occur in arable land or glacial drift. When the harder substances, such as rock or shale, are encountered a negative shrinkage or swell is found. Reliable data received by the committee shows that in many cases of work of this nature the swell has been from 2 or 3 per cent to 60 and 70 per cent.

The method of handling as well as the material will have a bearing on the swell of this material. Rock and shale will be found to vary considerably in different parts of the country. No rule is found that can be generally applied. The method of handling and shooting must be considered in anticipating swell. Local formations and conditions will govern to a great extent in this class of work.

It is estimated that approximately 90 per cent of the grading quantities in this country would be classed as earth or common excavation. Rock and shale work, therefore, would constitute only approximately 10 per cent of the quantities.

Conclusions

(1) Figure a shrinkage of 10 per cent on earth removed from excavation to embankment.

(2) Ascertain local conditions and results and use them as a guide in estimating swell of rock, considering nature of formation and method of handling.

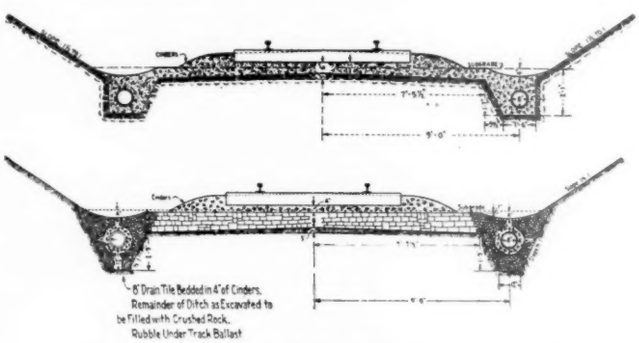
(3) The committee recommends that the conclusions on both shrinkage and subsidence be printed in the Manual and that the subjects be closed for the present.

Appendix F—Drainage of Large Cuts

In the location of a railroad, more careful study should be given than has sometimes been given in the past to provide proper and adequate drainage where it has seemed necessary to lay a grade line in what would be a long, low grade cut, and such a cut should be taken only when every means within reason has been employed to avoid it.

If such cuts be necessary, they should be taken out to such width as will permit of good, wide, deep, side ditches and the slopes made flat enough to avoid danger of the banks sloughing in, surface ditches should be provided wherever required, and these ditches should be kept far enough back to avoid seepage or sloughing into the cuts.

Wherever it is not possible to accomplish drainage by open ditches, there are various more or less desirable



Longitudinal Tiling for Wet and Springy Cuts

schemes which have, from time to time, been used by various roads for draining cuts, such as installing vitrified tiling, sometimes with lateral weepers, and sometimes without; in other cases, trenches have been excavated and backfilled with large or small rock, and with or without lateral weepers, and still more drastic methods have had to be resorted to where water springs have been encountered and the water seeps upward and outward from subterranean veins, these sometimes occurring directly beneath the track. Where necessary to put in longitudinal tile subdrains, they should be placed below the frost line and below any saturated material, laid to a true bed, and filled over with cinders or other suitable material.

All water possible should be kept from reaching the roadbed; side ditches should be provided in cuts in all or any class of material, in order to hold storm water down

away from the actual material and convey the water away as rapidly as possible; and, if then tile drains are still necessary, they should still be placed at satisfactory depth, and the cut ditches should still be kept open at all times; it being, of course, obvious that *all* ditches or drains must be kept open, as otherwise they defeat their own purpose. In hauling out cleanings from ditches or opening up new ditches, the material, if wasted, should be so placed that it cannot be washed back into the drain ditches or pipes in case of heavy storm.

Each year Drainage Districts are organized in territory adjoining railroads and where borrow pits exist are assessed exorbitant amounts for benefits assumed to accrue to embankments through drainage of the pits.

The report of the committee should be of value to the railroad by showing the effect of standing water, how best to overcome it, and whether or not drainage ditches will benefit track. If we should go on record with a report based upon replies received to date, which are to the effect that borrow pit drainage will relieve unstable track, we feel that the Association Proceedings will be in evidence at the trial of every Drainage District case and that the railroad companies will be further burdened by higher assessments.

The committee wishes to finally dispose of the subject, but it cannot do so without assistance. In view of its importance, we feel it would be unfortunate indeed if we had to recommend to the Association that the subject be withdrawn from further consideration.

There are very few railroads having no borrow pits, and it should be a comparatively easy matter to secure data as to their effect upon embankments under varying conditions. From many of the replies to our circular letter, it would appear that the effect of water in borrow pits is confused with that of water pockets.

The committee does not wish to prescribe any specific form of investigation that should be carried out, but rather that you follow your own ideas. What we are after is reliable data from which a conclusion may be reached.

Discussion

J. R. W. Ambrose (Chairman): This is one of the committees that believes in standardization, and where there are two or more ways of doing things, we believe that the A. R. E. A. way is the way it should be done.

In the absence of J. G. Little, the chairman of the sub-committee on the revision of the Manual, I will present that part of the report. We wish, in the first place, to standardize the spelling of the word "berm," at least for this Association. There is considerable difference in the pronunciation of the text word Subsidence. We propose the accent be placed in the "*si.*"

The definition for shrinkage was criticized somewhat by Mr. Wendt last year, and through the efforts of Mr. McVay's committee on subsidence and shrinkage, this new definition was formulated. The definition for settlement is entirely new, and we wish to delete the table on page 28 of the Manual in connection with the allowance for shrinkage, as it differs somewhat from Mr. McVay's report which will follow. *I move that this part of the report be approved.*

(After extended discussion of the definition for "shrinkage" the *motion was put and carried.*)

Chairman Ambrose: The second subject is "Subsidence and Shrinkage of Embankments." That is handled by Mr. McVay.

C. M. McVay (K. & M.): The sub-committee and the committee in general has put in considerable time in going over the information that was received, and submits the conclusions given in its Appendix B.

Chairman Ambrose: *I move that the conclusions be approved and incorporated in the Manual.*

G. A. Mountain (Can. Ry. Com.): I would like to ask how the conclusion was reached of figuring a shrinkage of 10 per cent on earth moved from excavation to embankment?

Mr. McVay: We had cases cited where the shrinkage would run as high as 40 to 60 per cent, other cases were given where the shrinkage was 2 and 3 per cent. Practically the only comparison that could be made was the quantity in the excavation and the same quantity in the embankment. Quite a lot of the information that is available does not carry that out far enough to give much information, but we found that 10 per cent was what would be used generally all over the country in ordinary earth excavation by practically all engineers in anticipating shrinkage, and we also found that the average of figure taken after the jobs were completed, where the figure was prepared in a usable shape, was very close to 10 per cent. I am free to say that that appears to be the general practice. Almost every railroad replying stated that 10 per cent shrinkage was allowed.

J. B. Jenkins (B. & O.): I will ask the committee if it will accept an amendment to Conclusion 1, inserting "of quantities measured in excavation" after "per cent," making it read: "Figure a shrinkage of 10 per cent on earth removed from excavation to embankment."

The reason I suggest this is that the I. C. C., where it has been applying a shrinkage of 10 per cent has been adding 10 per cent to the shrunken embankment quantities in order to ascertain the quantity of excavation, which results in a shrinkage of 9 per cent instead of 10.

Chairman Ambrose: There has been, as I understand, some dissension about the way this is to be applied, as to whether this yardage is from the source or in the opposite way. We found that in some cases it was applied one way, and in others in another way in different cases that were brought to our attention, but we did not feel like saying that it must be applied from the source or that it must be applied from the final location. The percentage, I believe, runs about 9.1 one way and approximately 11 the other way. The way it is written here it implies excavation, and that is, I think, the way that it is generally applied by the chief engineers of the roads from whom we got replies.

Mr. Jenkins: *I move that the words "measured in excavation" be inserted after "per cent."*

(*Motion carried.*)

The Chairman: That places the submission of these questions before you in an amended form.

E. A. Frink (S. A. L.): *I move to amend Conclusion No. 1 in Appendix 8 by including the words "in general" after the word "is," so the last sentence will read: "The percentage of subsidence is greater under small fills than under larger ones."*

The Chairman: The committee will accept that suggestion.

(*Motion carried.*)

Chairman Ambrose: The next subject is "Corrugated Metal Culverts." Mr. W. H. Penfield (C. M. & St. P.), chairman of that sub-committee, was called away suddenly last night. The committee collected considerable data regarding the use of corrugated metal culverts. It does not recommend the use of them as a permanent proposition, but only as a temporary one.

Chairman Ambrose: "Sealing Bad Cracks in Rock Cuts with Cement Gun." The committee has received considerable information on this subject from a number of roads, but the work is not far enough along yet to furnish any definite conclusions.

Chairman Ambrose: Standing water in borrow pits is the next subject. This subject was handled by Mr. W. C. Curd, chairman of the sub-committee, who will present the report.

W. C. Curd (Consult. Engr.): There seems to be a confusion existing between the effect of standing water in borrow pits and the water remaining on the track, and we have not been successful in getting specific locations from which we could report anything definite.

Chairman Ambrose: "Drainage of Larger Cuts," which was the last subject, will be presented by Mr. Robinson, Chairman of that sub-committee.

R. B. Robinson (U. P.): The sub-committee on this subject has thought that because of the drainage requirements, long soft cuts offered a condition that should be avoided in any reasonable way possible in the first place in not laying the line into such soft locations if it is reasonably possible to avoid it. After it may have been found necessary to lay a line into a condition of that kind, various methods have been used to carry off the water.

We are not attempting to say that any one method would solve every local condition that could arise.

Chairman Ambrose: *I move that these conclusions* 1, 2 *and* 3 *be adopted.*

(*Motion carried.*)

(The committee was excused with thanks.)

Report on Wooden Bridges and Trestles

Various types of wooden trestles have been studied with a view toward standardization. An analysis of designs shows a wide variation in stresses from those adopted by the A. R. E. A. A revision of allowable stresses is recommended in order to take advantage of the increased knowledge regarding different woods. Cooper's E65 is considered the maximum loading for wooden trestles built with the timber now generally available, while the E-55 loading is considered sufficient at the present time. Complete specifications for lumber and timber to be used in the construction and maintenance of way departments are presented for adoption.

W. H. Hoyt
Chairman

W. H. Hoyt is rounding out his third year as chairman of the committee, after serving for four years as vice-chairman. He was first appointed a member of the committee in 1914. He is an active worker in association activities, having been prominent in the work of the Duluth Engineers' Club, the Federated Engineering Societies of Minnesota and the American Society of Civil Engineers. He has been connected with the railways on the Iron Range of Minnesota since their inception. As assistant chief engineer of the Duluth, Missabe & Northern for 19 years and chief engineer for the past year he has had charge of ore dock development.

THE COMMITTEE PRESENTED a number of revisions of the Manual covering changes in definitions and minor changes in the text of the sections on guard rails and guard timbers, lag screws and specifications of workmanship. In Appendix A the committee submitted a progress study of the various types of wooden trestles with a view to recommending two or three standards adaptable for general railway use. In Appendix B the committee presented its specifications, classification and grading rules for timber and lumber for railroad purposes.

Conclusions

The committee recommended the adoption of the suggested revisions of the Manual and the adoption and publication in the Manual of its report on specifications, classification and grading rules for timber and lumber as given in Appendix B.

Committee: W. H. Hoyt (D. M. & N.), chairman; A. O. Ridgway (D. & R. G.), vice-chairman; H. Austill (M. & O.), F. C. Baluss (D. M. & N.), C. H. Blackman (L. & N.), M. J. Connerton (Sou.), H. J. Hansen, H. T. Hazen (C. N. R.), C. S. Heritage (Wash. Term.), E. M. Lewis (C. G. W.), J. B. Maddock (C. of G.), L. A. Murr (S. A. L.), D. W. Smith (H. V.), L. L. Sparrow (A. C. L.), G. C. Tuthill (M. C.), A. M. Van Auken, S. L. Wonson (M. P.).

Appendix A—Study of Various Types of Wooden Trestles

Forestry Bureau places supply of old lumber, not once cut over, as follows:

Southern yellow pine	139 billion ft. b.m.
Douglas fir	560 billion ft. b.m.

The National Lumber Manufacturers' Association reports as follows:

Douglas fir	595 billion ft. b.m.
Southern yellow pine	258 billion ft. b.m.
Oak	157 billion ft. b.m.
Cypress	23 billion ft. b.m.

Advices from southern mills are that there will be no difficulty in securing sixteen-inch timber as long as yellow pine is sawed commercially, and that prices will continue to be fixed by the market price of commercial lumber into which it can be sawed.

The sub-committee was unable to agree upon loading classification of trestles and the matter was referred to the main committee, which approved the following:

Light loading	Cooper's E-45
Medium loading	Cooper's E-55
Heavy loading	Cooper's E-65

Another question leading to much discussion was that of allowable stress. The stresses shown in the table in the Manual were excellent when adopted, but with the more concise definitions of timber and the increased knowledge of its strength, it should be possible to improve it.

The table of comparisons of stringer designs for wooden trestles was made from the data furnished by the table compiled from the answers to the questionnaire sent to the various railroads. These designs display American railway practice quite completely. No data was available relative to the maximum engine loading allowed on these structures by the railroads using them.

Column No. 4 is a coefficient which when multiplied by the individual wheel load will give the maximum moment for the span. Coefficient is calculated on the assumption that axles are spaced five feet apart and positions chosen to give the maximum moment. Simple beam action for one span only is considered. Partial

continuity due to beams being two span lengths adds to the factor of safety where this construction is used. Column 5 is the similar coefficient for maximum shear.

Column 10 gives the total width of the timber and for any given cap dimension will indicate the relative end bearing stresses between the cap and stringers. Column 11 gives the total cross-section area, useful in comparing end shearing stresses under like loading.

Column 14 gives ratios of actual bearing width to span length. The larger values indicate the more favorable stresses between the cap and the stringers. This ratio is only useful in comparing stresses from uniform loads. With concentrated loads the end stresses vary with the position of the loads.

Column 15 gives ratio of cross-section to the span length. The larger values indicate the more favorable stresses of shear at end sections. This ratio serves for comparisons only for uniform loads. With concentrated loads the end shear stresses vary with the position of the loads.

Column 16 gives ratio of section modulus to span length. The larger values indicate more favorable bending stresses. This ratio is only accurate for comparison under uniform loading.

Column 17 gives the values of the cube of the span length divided by the product of the width and cube of the depth of the stringers. All formula for deflection have this factor in combination with a factor of distribution of loading, weight of loading and the modulus of elasticity. Assuming these other factors constant, the factor $\frac{l^3}{bh^3}$ serves to show the relative deflections. The smaller values indicate small deflections and hence the more rigid chord.

Column 18 gives the ratio of the maximum moment coefficient for the span length to the section modulus of the chord used. The larger values indicate greater fiber stresses in bending. While the moment coefficients were calculated on wheel spacings of five feet, because modern locomotives rarely have spacings closer than five feet, this assumption will serve for the comparisons of spans up to include 16 feet.

Column 19 gives the ratio of maximum shear coefficient for the span length to the cross-section area. The larger values indicate greater unit stresses in both vertical and horizontal shear.

Columns 18 and 19 are better for comparisons of designs than columns 16 and 15, because in a wooden trestle live loads are more important than uniform dead loads in determining the stresses.

Columns under fiber stresses give values based on 40,000, 50,000 and 60,000-lb. axle loadings on five-foot spacings with no impact or dead load of deck stresses added. As the basic data does not indicate the limits of loadings put on the various railroad trestles by the railroads using them, it was thought best to display the effect of all three classes of loadings on each of the three determining points of design. Doubtless many of these structures were never designed to carry E-50 and E-60 loadings and may now be protected by limitation of engines allowed to pass over them.

The question of proper impact percentage to be added to the live load for these short spans of timber construction is still believed to be unsettled. However, any value used will materially increase the unit stresses above those shown in the tabulation.

Columns 23, 27 and 31 give the equivalent Cooper's rating assuming the stresses be limited to the amounts given in the table of "Working Unit Stresses for Structural Timber" in the Manual. These ratings were computed with dead loads of actual decks deducted from total carrying capacity.

In the recommended standards for loading, your committee finds that in many cases the maximum on any one span of trestle will occur when two 70-ton coal cars, fully loaded, and coupled, pass over the structure. Theoretically, this approximates Cooper's E-50 loading, but is thought to be no more severe on the structure than an engine of the E-45 class. It is believed E-55 will be sufficient for the present needs of nearly all the roads, as that load is exceeded as to its effect on trestles, by comparatively few engines now in service. In E-65, there is found the maximum load for which a practicable wooden trestle can be designed with the woods generally available for trestle construction.

As to the advisable length of panel, the committee agreed upon 12 ft. Yellow pine manufacturers have assured the committee that 16-in. stringers will be available without undue cost, as long as yellow pine lasts, but evaded promising an 18-in. stringer. Also, the 16-in. stringer is in general use at this time. With a 16-in. stringer agreed upon, the 12-ft. panel is very nearly a corollary.

Having fixed upon the panel length and loading, we proceed to the remaining features. First comes the pile.

Comparisons of Stringer Designs for Wooden Trestles

Reference Number of Railway using Stringers	Line No.	Span Length l Ft. In.	Span Coefficient for Max. Moment	Span Coefficient for Max. Shear	Design of Chord of Stringers: Number of Lines	Nominal Size of Timber Inches	Timber Measure Bd. Ft. Per Ft.	Actual Size of Timber Inches	Total Width b Inches	Total Area bh Sq. In.	Section Modulus bh²/6 In.³	bh³ In.⁴	Ratios for Comparisons: End Bearing Width to Span Length b/l	Cross Sect. Area to Span Length bh/l	Section Modulus to Span Length s/l	Coefficient for Deflection l³/kbh³	Moment Coef. to Sect. Mod.	Shear Coef. to Cross Sect.	Fiber Stresses and Equivalent Ratings: Bending Stress per Sq. In. from E40	Bending E50	Bending E60	Bending Cooper's Rating of 1200 lb per Sq. Inch	Longitudinal Shear Stress per Sq. In. from E40	Longitudinal Shear E50	Longitudinal Shear E60	Longitudinal Shear Cooper's Rating of 110 lb per Sq. Inch	Compression Across Grain Stress per Sq. In. from E40	Compression Across Grain E50	Compression Across Grain E60	Compression Across Grain Cooper's Rating of 340 lb per Sq. Inch	Line No.
(4)	1	10-0	1000	E5000	15000	3	7×14	24 1/2	6 1/2×13 1/2	20 1/2	279.38	615.09	4982.1	2.0250	2.734	61.51	.02007	.00406	.00549	975	1219	1463	47.5	165	206	247	24.5	168	210	252	72.1	1
(57)	2	10-0	1000	E5000	15000	3	10×16	26 1/2	9 1/2×15 1/2	43 1/2	302.25	780.81	7261.4	1.9500	3.023	78.08	.01377	.00320	.00496	768	961	1153	60.6	149	186	223	27.2	165	218	262	69.2	2
(52)	3	10-0	1000	E5000	15000	3	8×16	32	7 1/2×15 1/2	23 1/2	360.38	930.97	8658.0	2.3250	3.604	93.10	.01155	.00269	.00416	646	806	967	72.5	125	156	187	32.4	146	183	220	82.7	3
(29)	4	11-0	1331	31500	16363	3	8×16	32	7 1/2×15 1/2	23 1/2	360.38	930.97	8658.0	2.1450	3.276	86.33	.01537	.00349	.00484	838	1047	1257	55.5	136	170	204	29.7	160	200	240	75.7	4
(29)	5	11-6	1521	36250	14956	3	8×16	32	7 1/2×15 1/2	23 1/2	360.38	930.97	8658.0	2.0220	3134	79.23	.01737	.00389	.00471	938	1168	1402	49.6	141	176	212	28.6	166	207	248	72.9	5
(47)	6	11-9	1622	38125	17734	3	8×16	32	7 1/2×15 1/2	23 1/2	360.38	930.97	8658.0	1.9787	30.67	79.23	.01874	.00410	.00478	983	1229	1474	47.2	143	179	215	27.3	144	180	216	66.3	6
STD from E45	7	12-0	1728	40000	17500	3	7×16	28	6 1/2×15 1/2	20 1/2	313.88	810.84	7540.6	1.6875	26.16	67.57	.02291	.00493	.00558	1264	1580	1896	38.8	167	209	251	23.7	196	245	294	61.2	7
(24)(30)(31)(27)(6)(12)	8	12-0	1728	40000	17500	3	8×16	32	7 1/2×15 1/2	23 1/2	360.38	930.97	8658.0	1.9375	30.03	77.58	.01996	.00430	.00486	979	1223	1468	44.8	147	182	219	27.6	171	214	256	70.6	8
STD from E50 (40)	9	12-0	1728	40000	17500	3	8×16	32	7 1/2×15 1/2	23 1/2	360.38	930.97	8658.0	1.9375	30.03	77.58	.01996	.00430	.00486	979	1223	1468	44.8	147	182	219	27.6	146	182	219	82.9	9
E45 to E55	10	12-0	1728	40000	17500	4	7×16	37 1/2	6 1/2×15 1/2	27	418.50	1081.12	10039.5	2.2500	34.88	90.09	.01719	.00370	.00418	888	1110	1332	52.1	125	157	188	32.1	126	157	189	96.4	10
(13)	11	12-0	1728	40000	17500	3	10×16	40	9 1/2×15 1/2	29 1/2	453.40	1171.20	10892.3	2.4375	37.81	97.60	.01586	.00342	.00386	820	1025	1230	56.1	116	145	174	34.3	136	170	204	88.6	11
(42)	42	13-9	3907	68125	20952	3	9×16 / 6×16	44	9 1/2×15 1/2	32	496.00	1281.30	11916.6	2.0317	31.49	81.35	.03279	.00532	.00822	1276	1595	1914	33.4	127	158	190	30.0	150	187	225	79.9	42
(43)	43	13-9	3907	68125	20952	3	9×16 / 6×16	49 1/2	9 1/2×17 1/2	32	560.00	1633.00	17150.0	2.0317	33.56	103.68	.02278	.00417	.00374	1001	1252	1502	45.7	112	140	168	35.5	150	187	225	79.9	43
(44)	44	13-9	3907	68125	20952	3 1/2	7×16 / 6×16	50	9 1/2×16	34 1/2	563.00	1456.50	13545.6	2.3095	35.80	92.48	.02.884	.00468	.00372	1123	1403	1684	40.7	111	140	167	35.5	132	165	198	91.1	44
(22)(23)	45	16-0	4096	78000	21250	3	8×16	32	7 1/2×15 1/2	23 1/2	360.38	930.97	8658.0	1.4531	22.52	58.19	.04731	.00752	.00590	1565	1956	2347	24.9	176	220	264	22.2	208	260	312	57.5	45
(16)	46	16-0	4096	78000	21250	3	8×16	32	7 1/2×15 1/2	23 1/2	360.38	930.97	8658.0	1.4531	22.52	58.19	.04731	.00752	.00590	1565	1956	2347	24.9	176	220	264	22.2	167	222	278	67.5	46
(23)	47	16-0	4096	70000	21250	3	10×16	40	9 1/2×15 1/2	29 1/2	453.40	1171.20	10892.3	1.8281	28.33	73.28	.03760	.00598	.00469	1919	2393	2872	31.3	140	175	210	28.0	141	177	212	85.2	47
(24)	48	16-0	4096	70000	21250	3	10×18	45	9 1/2×17 1/2	29 1/2	511.90	1493.00	15676.2	1.8281	31.99	93.31	.02613	.00469	.00418	1125	1407	1688	40.6	124	155	186	31.9	141	177	212	85.1	48
(28)	49	16-0	4096	70000	21250	4	8×18	48	7 1/2×17 1/2	31	542.50	1582.30	16614.1	1.9395	33.91	98.89	.02465	.00424	.00332	1062	1327	1593	43.8	117	146	175	33.8	133	167	200	90.2	49
(59)	50	16-8	4096	70000	21250	4	9×18	54	8 1/2×17 1/2	35	612.50	1786.50	18753.8	2.1875	38.28	111.65	.02184	.00332	.00349	940	1176	1411	48.8	103	129	155	38.5	118	148	177	104.6	50
Column Number		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32
Column Relationship															10÷2	11÷2	12÷2	3÷13	4÷12	5÷11													

We will not discuss varieties of timber, believing the engineer will use the best available, and make up for any lack of structural strength by increasing the size. It is also thought a 14-in. butt will be the minimum size used. It was assumed that piles should, if possible, be so driven as to be safe for a load of 15 tons plus impact.

Class	Rating	Load on Bent	No. of Piles	Load on Pile	Load Per Sq. In. Area Cap on Pile
Light	E45	56 tons	4	14 tons	210 lb.
Medium	E55	68 tons	5	13.6 tons	177 lb.
Heavy	E65	80 tons	6	13.3 tons	173 lb.

In the event it becomes necessary to strengthen E-45 to carry E-55 load, or E-55 to carry E-65 load, the weight would be 17 tons and 16 tons respectively on the piles, which would be permissible.

So many varieties of woods are used for caps that only a general rule applying to pine, cypress and fir can be used. It is recommended that the following be used:

Light	12 in. x 14 in. x 14 ft.
Medium	14 in. x 14 in. x 14 ft.
Heavy	14 in. x 14 in. x 14 ft.

While more than 13 ft. in length may be unnecessary, since we must pay for even feet there is no cogent reason against using such length. Caps should be surfaced on one or two sides and not dapped over the pile. Dapping is expensive and weakens the cap.

Sway bracing should ordinarily be used on all bents over 10 ft. from surface of ground to base of rail. When this distance exceeds 18 ft. there should be two or more sash braces and corresponding sway braces. Bracing should be on both sides of the pile. The aim should be to so attach the braces as to enable them to give the bent the maximum strength. The bank bent should be the same as the intermediate bent, save that no bracing is required and that in the E-65 design only five piles are recommended for the bank bent.

For frame bents the committee's recommendations are:

	Cap	Posts	Sill
Light	12x12x14	4—12x12	12x12
Medium	14x14x14	5—12x12	12x12
Heavy	14x14x14	6—12x12	12x12

The committee asked further time for consideration of design of multiple story bents and their bracing. The batter to be used for piles and posts in trestle construction has been given consideration, but no recommendations are made at this time. No conclusion has been reached relative to details of fastenings to be used in securing the posts to sills or caps to posts. Sway bracing in single story bents should be the same size as in pile bents and similarly attached. In considering stringers, it was recognized that the two lighter types should be readily strengthened for the next higher loading and in our plans this can be accomplished by inserting an additional stringer under each rail. It is recommended:

Class	Size of Stringers	Fiber Stress, Lb. Per Sq. In.	Long Shear, Lb. Per Sq. In.	Compression on Cap, Lb. Per Sq. In.
Light	6—7x16	1422 lb.	188 lb.	221 lb.
Medium	6—8x16	1346 lb.	180 lb.	200 lb.
Heavy	8—8x16	1257 lb.	178 lb.	178 lb.

It will be noted that in longitudinal shear the stresses much exceed those given in either of the tables before referred to.

Ties should be 8 in. x 8 in. x 10 in. surfaced on one side, not dapped, 12-in. centers and attached to stringers in accordance with recommended practice of the A. R. E. A. Guard timbers should be 4 in. x 8 in. attached to ties according to recommended practice of the A. R. E. A.

Discussion

W. H. Hoyt (Chairman): The first subject, the revision of the Manual, was in charge of Mr. Ridgway, but in his absence Mr. Austill will present the matter.

(Mr. H. Austill (M. & O.) presented the matter under "Revision of Manual.")

Chairman Hoyt: *I move that the recommended changes of the committee be adopted and incorporated in the Manual.*

G. A. Mountain (Can. Ry. Com.): There is a term used by the committee under "Use of guard rails and guard timbers for wooden bridges and trestles." It is recommended that the inner guard rail, when used, shall be so spaced, etc. I think it is common practice to use an inner guard rail, and this expression would seem to convey the idea that the committee does not recommend it entirely.

Chairman Hoyt: That is in the present Manual, and the question is optional with the designing engineer as to whether to use guard timber or not. I am informed that that matter was up at a previous meeting, and a motion to make it standard practice to use an inner guard rail was not approved, and that is the reason that the committee left that clause "when used" in there. Of course, it is possible to bring the matter up at the present time to decide whether it shall remain or not.

Mr. Mountain: In our practice in Canada it is standard.

Chairman Hoyt: The practice is nearly so in the United States, but there may be a number of cases where it does not apply.

Motion carried.

Chairman Hoyt: The second subject assigned was "Specifications and Classification and Grading Rules for Lumber and Timber to Be Used in the Construction and Maintenance of Way Departments of Railroads." This subject has been before the committee for the past three years. It has again been gone over this year; a number of revisions and improvements made as we see it and it is now submitted with a view to final approval for printed as recommended practice.

The President: On the question of ties, something was said yesterday about the correlation between the recommendations of various committees as to ties and those of the Tie committee.

Chairman Hoyt: As we have taken up the question of ties, we only make recommendations for ties for wooden bridges and trestles. We do not deal with track ties as such.

The question arises as to switch ties, sawed. It was intended that this clause would apply only to structural oak for bridge purposes. If there seems to be any conflict with the report of the Tie committee, that particular paragraph can be omitted, but I see no reason why it should be.

F. R. Layng (B. & L. E.): I think that should be done. These specifications cover wooden bridges and trestles, and should not conflict with the specifications of the tie committee. I suggest the Board has been a little liberal in its assignment to this particular committee.

The President: I think that is true, it is a matter to be handled by the Board. This suggestion is noted and the committee on outline of work will take that out.

Chairman Hoyt: *I move the adoption of the specifications in the Manual as recommended practice.*

(A recess was taken for lunch.)

Chairman Hoyt: I want to bring up the matter of uniform sizes, which was one of our hard nuts to crack. This received endorsement of the largest number of consumers that have ever got together in a particular matter. They held a meeting in Chicago last year representing practically all of the retail lumber dealers of the country. This question was thoroughly gone over, and they favored and approved standard uniform sizes. To make anything of that kind effective it requires the backing of the consumers everywhere, and that is the

reason that we inserted and are in favor of definite uniform sizes for lumber.

(The pending motion carried.)

Chairman Hoyt: There is one other report that this committee offers for a progress report. This sub-committee's report is submitted in Appendix A. I would ask Mr. Van Auken to explain the features of the report as far as the work has progressed up to the present time.

A. M. Van Auken (Monon): Our report as you will see is only a progress report. There were five members on our sub-committee, and there were five opinions on nearly every subject that came up. We have tried to work out some of the bigger questions in this problem, and we put the results before you.

(Mr. Van Auken abstracted Appendix A), and said: We corresponded with the mills and the Forestry Bureau about sizes. A good many of them did not give us very much of an answer, but the Forestry Bureau sent us a pamphlet and gave the sizes of standing timber in yellow pine which indicates that 26-ft. stringers, 16-in. in the largest dimension, could be sawed out of a very considerable portion of the standing yellow pine.

I made a rough estimate of the amount of wooden trestles on roads, and replying found that a very considerable majority still use yellow pine stringers; consequently it was necessary that we should not adopt a set of standard plans, that would eliminate the larger portion of the railroads.

The principal reason for adopting E-45 as the lightest loading was the fact that practically every road is liable to haul over it two heavy coal cars coupled, and that is practically an E-50 load; but due to conditions we all understand, the committee adopted E-45. With a 16-in. stringer we could not carry these loads on a longer span than 12 ft. The recommendations agree with that.

E. A. Frink (S. A. L.): Some of you may remember that I objected very strongly last year to the loading adopted, and I think there is much more justification for the loading on trestles than there would be on bridges, because the margin of overstrain is not nearly as large. It does not seem to me, however, that we ought to use standard loading of E-45, 55 and 65 for timber trestles used in the same track with steel bridges, with a standard of E-60. It seems to me as though the loading of the trestle ought to correspond with the bridge that has to carry the same load. I think the committee would do well to revise those loadings and agree to load with steel bridge specifications.

I question the statement of the committee about paying for even feet, for stringers are universally ordered in double panel lengths, so that there is no objection to buying panel lengths in even feet. I do not say I advocate that. I am suggesting it for the consideration of the committee.

I also question the statement of the committee about the use of 16-in. stringers instead of perhaps 14. While it is perfectly possible to get 16-in. stringers from our southern mills, yet it has been my experience that you pay more per thousand feet for 16-in. than you do for 14-in., and more for 14-in. than you do for 12-in. Therefore, I think some method should be allowed to have the road use whatever size of stringers which best suits their practice. The road I represent has used 14-in. stringers for years and is using them now.

Chairman Hoyt: The discussion that has been brought out by Mr. Frink is just exactly what we want. The more data and the more information of that sort that we can get, the better we will be satisfied.

(Committee was excused with thanks.)

Report of Committee on Wood Preservation

Inspection of ties treated with water gas tar shows that good results may be obtained with this preservative. Tests on toxicity of sodium fluoride indicate it to be about double that of zinc chloride. To date it has only been used for experimental purposes. It is recommended that test sections of track be installed for the further study of this preservative. Attacks of marine borers on exposed piling are of late more extensive and severe than formerly. Creosoting, when properly carried out, will protect piling from attacks of teredo on the Atlantic coast, but on the Gulf coast it is often inadequate. Creosote has not been found to stop the attacks of limnoria.

C. Marshall Taylor
Chairman

C. Marshall Taylor, the chairman of this committee for the last three years, is now also the president of the American Wood Preservers' Association and, like a considerable number of others interested in that special branch of engineering, he has consistently divided his time and efforts between the Wood Preservers' Association and the committee on that subject in the A. R. E. A., of which he has been a member for 11 years. Mr. Taylor is the superintendent of the Port Reading Creosoting Plant of the Philadelphia & Reading and the Central Railroad of New Jersey, but has also had an opportunity to view timber treatment's commercial side.

IN APPENDIX A THE COMMITTEE submitted service test records covering two kinds of work, one on the service of ties in experimental tracks, which are covered by reports from the Baltimore & Ohio, St. Louis-San Francisco, Chicago, Indianapolis & Louisville, the Santa Fe, and the Chicago, Rock Island & Pacific, and the second class is by reports of the Cleveland, Cincinnati, Chicago & St. Louis, showing the total number of ties they have put in track and taken out from the year 1905 until 1919, inclusive.

In Appendix B the committee reported on the subject of water gas tar as a preservative. The use of sodium fluoride as a preservative for cross-ties is covered by the report of committee as given in Appendix C, while in Appendix D the committee reported on the protection of piles in water infested by marine borers.

Conclusions

1. The committee recommended that further reports on indicators for determining burnettizing of ties and timbers be eliminated, as this matter seems to have been covered fully in previous reports.

2. The committee recommended that the question of the comparative values of Grades 1, 2 and 3 creosote oil and creosote coal-tar solution is one that is not definable in any way so that conclusions can be considered for adoption as recommended practice.

3. The committee recommended that no further consideration be given to the proposition of trying to develop comparative values of Grades 1, 2 and 3 creosote oil and creosote coal-tar solution.

Appendix A—Service Test Records

The reports submitted by the Chicago, Rock Island & Pacific, the St. Louis-San Francisco, the Baltimore & Ohio, the Santa Fe System and the Chicago, Indianapolis & Louisville, are made up from test sections. In adopting this method much more reliable data is obtained, for the reason that a record of each particular tie in these sections is kept, and, furthermore, a close supervision is kept over these sections enabling those responsible of keeping a close supervision, both in tie renewals and tie removals. It is a distinct advantage to keep each class of wood used in these sections separately in reporting, as by so doing the average life of each kind of wood may be easily determined.

While it is possible that the form used might be improved upon, it is suggested that the next committee be instructed to follow up this question with the view of having this form, or one similar, adopted by all roads as standard, which would result in making the reports of more value to all concerned.

Appendix B—Merits of Water-Gas-Tar as a Preservative

The report of the committee in 1917 contained an account of the ties treated by the United Gas Improvement Company of Philadelphia and placed in the track of the Public Service Company of New Jersey. They were treated in 1911 with the full-cell treatment of 10 lb. per cubic foot. The manner in which these ties were treated, together with the analysis of the oil used and their location, was given in detail in that report. On December 1, 1919, the ties were again inspected and were apparently in excellent condition, none having been removed on account of decay. They are mostly Florida pine 6x8 in. by 8 ft. and have now given approximately 9 years' life.

In November, 1914, the Baltimore & Ohio placed 600 red oak ties in a test track at Herring Run, Md. They were treated by the United Gas Improvement Company at Philadelphia with water-gas-tar. An inspection of these ties was made on September 16, 1920, with the result that after six years no signs of decay were found, while 63 per cent of the untreated red oak ties placed in the same track have been removed account of decay. Two of the ties were taken out of this track for test. Each tie was sawed in two and one-half of each sent to the Baltimore & Ohio laboratory at Baltimore; half of one tie to the laboratory of the Port Reading Creosoting Plant at Port Reading, N. J., and half of one tie to the laboratory of the United Gas Improvement Company at Philadelphia. The oil was extracted and analyzed with the following results:

	Tie No. 1805 B. & O. Analysis	Tie No. 1960 B. & O. Analysis
Specific gravity, 38°/15° C.	1.085	1.108
Distilling below 205° C.	.6	4.2
205° to 235° C.	2.6	...
235° to 245° C.	2.8	3.1
245° to 275° C.	7.4	4.1
275° to 315° C.	7.4	14.7
315° to 330° C.	9.7	10.6
Residue	69.1	63.2
Loss	.4	.1

The ties appeared to be in good condition, although in several sections rails had been respiked and the old spike holes were not plugged. No treated ties have been removed except those for the purpose of test. In view of the good results so far obtained in the treatment of cross-ties with water-gas-tar, it is suggested that other railroads install test tracks, and keep a careful record of the comparative life of cross-ties treated with water-gas-tar alone, or combined with coal-tar-creosote, zinc chloride, or other preservatives.

Appendix C—Availability and Use of Sodium Fluoride as a Preservative

Sodium fluoride has been used only in very small amounts for the preservation of ties, and that only for experimental purposes, and comparatively little is available for the preservation of ties at this time. Lack of a demand and an immediate shortage of high-grade fluor spar has deterred manufacturers in increasing their facilities for its preparation. Its recovery as a by-product from the manufacture of phosphate fertilizer is not being carried out because of the high initial outlay in plant construction under present conditions of labor and material shortages.

Tests on the toxicity of sodium fluoride as made by the Forest Products Laboratory, Madison, Wis., indicate it to be about double that of zinc chloride. Service tests on ties treated with this salt have not been carried on over a period sufficiently long to determine if this same ratio holds true in practice. Until this information is at hand, it appears that no railroad going into the extensive use of sodium fluoride for the treatment of ties would be warranted at this time, in using an amount much less than is customary when treating with zinc chloride, i. e., ½ lb. per cb. ft. of wood. Under the circumstances, the comparative prices of zinc chloride and sodium fluoride will determine whether or not the former will be supplanted by the latter, wholly or in part.

Recent developments indicate that there is a possibility that sodium fluoride will be obtainable at a price very nearly that of zinc chloride. This situation, therefore, causes the committee to suggest that any railroad maintaining experimental tracks should arrange to install a sufficient number of ties treated with sodium fluoride to obtain test records from which definite conclusions may be drawn.

Appendix D—Protection of Piles in Water Infested by Marine Borers

There are many varieties of borers present in the coast waters bordering the United States, but as far as protecting against them is concerned there are only two that need be considered, viz., the mollusk, represented by the various species of teredo, and the crustacean, represented by the limnoria and to some extent the sphaeroma. Protection that is effective against these is also effective against any others so far encountered. The borers breed faster and their attack is more severe in warm than in cold water, in clean water than dirty water, and in salty than brackish water. The action of limnoria is affected by the velocity of the current so that each location presents a problem in protection by itself, and a method that is effective in one location may be ineffective in another.

The activity of these borers is as a rule affected by the same conditions; however, their simultaneous presence is not always the rule nor is their activity necessarily the same, although found in the same location; as an example, the teredo is active in Norfolk harbor, but there are very few, if any, limnoria. The range of action of the teredo is from a point above low water mark to a depth of 25 to 30 ft., or to mud line. The attack of the limnoria is most severe between high and low water, but extends down to about the same depth as that of the teredo. In

Charleston harbor, where limnoria is particularly active, there are creosoted piles which are badly eaten at low water mark, but which have been attacked only to a slight extent in patches below low water. Untreated piles in these waters are quickly attacked by the limnoria at all depths to the mud line.

Creosoting has been relied upon to a great extent for protection against the attacks of marine borers and experience has shown that where properly carried out, from the selection of the timber to the driving in the structure, creosoting will generally stop the teredo at points on the Atlantic coast north of Florida, but that at points on the Gulf and Pacific coasts where the teredo is more active creosote treatment is often inadequate.

On the Atlantic and Gulf coasts the piling treated for marine use is usually pine and on the Pacific coast Douglas fir. The piling should be free from knots or other imperfections that will interfere with the creosoting. The inner bark should be completely removed and as much creosote oil should be injected as the wood is capable of taking up. After treatment the piles should be handled in such a manner as to avoid tearing the wood or abrazing it in any way that will weaken or break through the treated area, and they should not be cut or bored below high water mark, the idea being to present to the teredo a perfect and impervious armor of creosoted material without holes or weak spots. As it is impossible to secure perfect material, perfect treatment and perfect handling the creosoting process as ordinarily applied can be considered as effective only in greatly retarding the action of the teredo.

Creosote so far has not been found to stop the attacks of limnoria. On the most carefully treated specimens of pile south of Norfolk on the Atlantic coast, the Gulf coast and on the Pacific coast their action is noticed after three to six years, probably as soon as the creosote has lost some of its toxic properties through leaching, and when once started their action progresses rapidly. In view of this experience, at points where the borers are very active, it is the practice of many who desire to insure a greater permanence of protection to piles in important structures to apply mechanical protection to the piles in addition to cresoting. Piles that receive mechanical protection are creosoted in addition in order to prevent decay above the water and also retard the attacks of borers until repairs can be made in case the mechanical protection becomes damaged.

Cast Iron Cases

These cases are made in halves so that they can be placed in position after the piles have been driven and capped. As the castings are bolted together the casing is lowered to the mud line and forced down into the mud. The space between the case and pile is usually filled with sand and capped with cement mortar to prevent the sand being washed out by the waves. This protection is entirely efficient as long as the jacket remains intact. Cast iron corrodes very slowly in sea water and if made thick enough will resist corrosion a great many years. Some of these cases at points on the Gulf have been in position about 30 years. Care must be observed that the cases go far enough into the mud so that the piles will not be uncovered by the washing away of the mud, or by dredging operation. In this event the sand escapes and the entire pile is exposed to a current of sea water and then to attack by the borers.

Vitrified Pipe Cases

In locations not exposed to wave action and the pounding of drift, vitrified pipe can be substituted for cast iron. It does not corrode, but is easily broken. The pipe sections are preferably in one piece and placed over the pile before it is capped. The sections are cemented together, lowered to the bottom and forced into the mud. The space between the case and the pile is filled with sand and capped with cement mortar.

This protection has been much used along the Gulf and Pacific coast, where full length protection is necessary, and is entirely efficient as long as it remains intact. Any defects in the case below the water will be shown by the escaping sand and any broken pipe sections can be easily replaced. It is the custom in maintaining these cases to make inspections and repairs about once a year. For protecting piles after they have been capped, or for making renewals, the pipe sections are made in halves and are joined together with some form of lock or copper wire, or treated wooden plugs.

Reinforced Concrete Cases

Cases less fragile than vitrified pipe and less expensive than cast iron can be made of reinforced concrete.

The sections can be made in one piece for placing before the pile is capped, or in halves for placing afterward. One design provides for a lock by leaving some of the reinforcing wires projecting so that they can be twisted together and covered with cement mortar after the halves have been joined. For these cases the concrete casing over the reinforcement is rather thin, and there is some question whether the reinforcement will corrode and the cases go to pieces under the action of sea water. Service tests are needed to develop this point.

Concrete Jackets Cast in Place

Considerable protection work has been done of late in Charleston, S. C., waters by casting concrete jackets in place about the piles. In these waters the teredo is less active than at points on the gulf, and is successfully controlled by careful creosoting. The limnoria is very active and will finally cut off creosoted piles at about low water mark. It does not seem to work progressively on treated piles at depth greater than two feet below low water mark, although piles that have been pulled show traces of attack in isolated patches all the way to the mud line. Under these conditions, protection for a length of about 10 ft., extending from about three feet below low water to about two feet above high water, is efficient. Some of these jackets are plain concrete and some are reinforced.

Casting the concrete jacket in place has the advantage of restoring in a measure the strength of the pile, even though its section may have been reduced materially. On a protecting job now going on in Charleston jackets of plain concrete are being used. These are about 3 in. thick and the concrete is 1-2-4 mix with fine aggregate. The forms are No. 24 gage galvanized iron, the sheet being wide enough to form a complete section. The two edges are nailed to wooden strips about 2½ in. square, one of which has a tongue and the other a groove. The sheets are placed around the pile and the wooden strips clamped together. A tight, smooth concrete form is obtained. By using forms made in this way concrete jackets have been carried as much as 12 ft. below low water, and good results obtained.

Nails, Sheet Metal, Tar, Etc.

The oldest method of protection of which we have knowledge is studding the exposed surface with nail heads. Its virtue does not seem to lie entirely in covering the exposed surface with nail heads, but is still effective when not more than one-fourth the surface is covered by the heads. Several plain piles studded with nails were driven about 2½ years ago in Charleston harbor. The nails have heads about ¼ in. in diameter and were driven

½ in. to ¾ in. apart. The piles are entirely free from attacks by borers, whereas a plain pile without the nails driven at the same time has been reduced at low water line by the action of the limnoria from about 10 in. to about 5 in. in diameter.

Sheets of copper and zinc have been used with success in many places for protection against marine borers. This protection is entirely efficient as long as it remains intact. However, full length protection must be applied before the pile is driven and it is likely to be broken in handling. Copper is not affected by salt water, but zinc soon corrodes. It is stated that some of the brands of rust-resisting sheet iron will withstand the action of sea water for several years, and it is possible that that material could be used to advantage under some conditions rather than copper, which is too expensive. Many attempts have been made to provide a durable protection by applying coatings of tar or asphalt either alone or combined with some fabrics. These coatings are efficient as long as they can be kept intact, but they are likely to be broken by handling, or by the pounding of drift, and they have in general proved unreliable. Bark left on piles will protect against marine borers, therefore, when plain piles are used in infested waters their life can generally generally be strengthened by leaving the bark on.

Discussion

C. M. Taylor (P. & R.): Chairman. The report on wood preservation this year is full of information without any definite recommendations for the Manual. A part of the report that should appeal to each and every maintenance engineer is given in Appendix A on service test records. These records have resulted from experimental track in most cases on the Rock Island, the St. Louis-San Francisco, the Baltimore & Ohio, the Santa Fe, and Monon and the Big Four. In all cases except the Big Four their result is obtained through the insertion of experimental track sections. The first report will be the results obtained on the Rock Island, which will be presented to you by Mr. Ford.

(C. F. Ford (C. R. I. & P.) presented his report.)

Chairman Taylor: Are there any comments to be made on the result of the tests on the Rock Island? You will note that they cover three different treatments, and are giving very satisfactory records.

Mr. O. C. Steinmayer (St. L.-S. F.) is not present, but I would call your attention to the report of the Frisco. It is very interesting to note that the white oak, the basis for comparison in most tie work, does not show up as well as a great many people think it should.

F. J. Angier (B. & O.): The tests on the Baltimore & Ohio are in test tracks. We are not trying to keep a record of ties. We have 8 or 10 test tracks, the most important is the one that is just east of Baltimore—Herring Run. We put in 3,300 red oak ties in this test track. They all were put in under the same ballast conditions with screw spikes and tie plates and treated in 10 different ways. Three hundred ties were put in untreated. The others were treated with zinc chloride, with sodium fluoride, water gas tar, coal tar, creosote, mixtures of coal tar, creosote and zinc chloride.

The statement of the report is a little misleading. It shows the percentage of ties removed from all causes, and in this particular test track at Herring Run it shows that 300 ties treated with zinc chloride, 42 per cent have been removed, but not a single tie has been removed for decay. Those ties were removed on account of putting in a switch, and on account of a derailment on this track. It seems to me that it would be better if we could use two columns, one showing the number of ties taken out on account of decay, and the other for other causes.

Chairman Taylor: The result of the A. T. & S. F. test will be given by Mr. R. S. Belcher.

R. S. Belcher (A. T. & S. F.): The only difference between the test sections and the ordinary sections is that an individual record of each tie is kept. We have one or two special tests where ties were put in out of place, and possibly our oldest test of this kind and the most remarkable is the one made on the "Ottawa Cut-off." This represents about 24,000 ties that were put in in 1906, ordinary hewn Lobolly pine, which our reports show were treated with creosote, and although these ties have been in more than 14 years, only 357 have been taken out to date, and none because of decay. The principal reason for removing the 357 ties is derailments and breakage.

Chairman Taylor: The next report will be that of the Big Four, which is along entirely different lines. It is a history of their treated tie work from the time they started until the end of 1919. In other words, it is the whole story, and I will ask Dr. von Schrenk to explain the report.

Dr. Von Schrenk (Cons. Timber Engr.): Without going into the details of the interesting phases which have developed through a recent study of the tie record, the point I wish to call particular attention to is that these figures represent as nearly as possible an actual count of every tie, both treated and untreated, inserted on the Big Four System since 1905. The Big Four adopted the practice of putting a date nail into both treated and untreated ties. As careful a record as possible has been kept of all removals by years. You will note that the tie insertions have dropped from 369 ties to the mile to 201 in 1919, or a reduction of 168 ties in the mile. This record shows in a striking way that the probable life that we are attaining from these early ties give every indication that every tie in the railroad should be a treated tie.

Chairman Taylor: The next portion of the report is shown in Appendix B, Merits of Water-Gas as a Preservative. This portion of the report will be presented by Mr. Angier.

(Mr. Angier then presented Appendix B.)

Chairman Taylor: The next subject reported on is Availability and Use of Sodium Fluoride as a Preservative for Cross-ties. Sodium fluoride has certain apparent advantages in the treatment of cross-ties, and the committee suggests that any railroad maintaining experimental tracks should install a certain number of ties treated with sodium fluoride and maintain records from which conclusions may be drawn.

On Subject 8, Comparative Values of Grades 1, 2 and 3 Creosote Oil and Creosote Coal-Tar Solution, the committee feels that the report as given last year covers the situation as well as it is able to put it in writing, and in connection with Subject 9, Accelerated Tests of Grades 1, 2 and 3 Creosote Oil and Creosote Coal-Tar Solution, the committee has unfortunately not been able to develop reliable methods for making any such accelerated tests.

With reference to Conclusion 2, the committee felt that the data it has in hand at the present time does not enable it to give you something you can put in the Manual. The committee does feel, however, as time goes on that it may have something on the comparative values of Grades 1, 2 and 3, but it also wishes to say it is not something that can be decided immediately, because it is interwoven with so many other problems in connection with the committee work. It is difficult for the committee to formulate any definite conclusion that it would dare ask to be put in the Manual. The committee feels that this subject is one that all future committees should

consider, and if at some time they are able to give you something that is worthy of insertion in the Manual, they feel that such will be done.

With reference to Conclusion 3, Chairman Taylor said: It was the thought of the Committee of Direction that this committee could develop something that would determine this matter very quickly, and they suggested accelerating tests to show this differentiation in values. The committee is very frank in saying that it is an absolute impossibility, and for that reason it recommends that no further consideration be given to the subject. It is one of those things which cannot be done quickly.

(The committee was then excused with the thanks of the Association.)

Report on Rules and Organization

In the manual of instructions for the guidance of engineering field parties the committee submitted an abstract of H. H. Edgerton's monograph. The subject matter, revised, is submitted for inclusion in the Manual. The chief work submitted is a manual of rules for the guidance of maintenance of way employees. While presented for inclusion in the Manual, it is recommended that it be considered as a live document to which additions or changes can be made as railway practices change. Safety rules affecting the different classes of employees are incorporated as a part of the regular rules governing employees working on or about the track.

W. C. Barrett
Chairman

W. C. Barrett is now completing his first year as chairman of the committee and his third year as a member. He has been able, through his experience first as division engineer on the Lehigh Valley and more recently as trainmaster, to learn and appreciate the importance of well-thought-out practical rules for the guidance of those employees concerned with engineering and maintenance of way and also with the operating departments as well. Mr. Barrett is a conscientious and interested student in the fundamental problems of railroad organization and operation which are so pressing today, and in any development that will help solve these problems.

THE COMMITTEE, IN APPENDIX A, presented its report on instructions for the guidance of engineering field parties; in Appendix B its rules for the guidance of employees of the maintenance of way department and in Appendix C its report on the science of organization.

In Appendix B the committee endeavored to make the rules general rather than special, and to so frame them that any road could use the work as a foundation for a book of rules and insert special rules as desired. The "General Notice" covers rules found in the standard code under the same heading. Under "General Rules" the committee placed rules applicable to all employees, so as to avoid, as far as possible, repetitions under each class. Under "Operating Rules" the committee placed those rules taken from the standard code and a few special rules which it is thought necessary and desirable for maintenance of way employees to know. Under "Rules for the Government of Employees Working on or about the Track" was placed what are usually called "Safety Rules." The committee also included "Rules for the Operation of Motor, Hand, Velocipede and Push Cars."

Under "Divisional Maintenance Officers" it was the endeavor to cover the positions common to most railroads and the usual duties of each. Individual roads may not have all the positions mentioned, or may have others not mentioned, or may not use the same titles for the positions. Under "Conduct of Work" the committee submitted "Rules for the Conduct of Track Work," or work to be performed by the forces under the supervisors of track only. The committee requested that it be permitted to submit "Rules for the Conduct of Bridge and Building, Signal and Telegraph and Telephone Work" next year.

The committee asked that the Association consider the "Manual of Rules for the Guidance of Employees of the Maintenance of Way Department" as a live document to be added to or changed in some details each year, as new methods or practices are developed, or present methods or practices become obsolete and better ones replace them.

Conclusions

(1) The committee recommended the adoption of the "Manual of Instructions for the Guidance of Engineering Field Parties" and the "Manual of Rules for the Guidance of Employees of the Maintenance of Way Department" and that these be substituted for all of the matter now appearing in the Association Manual under "Rules and Organization."

(2) The committee recommended that the "Manual of Instructions for the Guidance of Engineering Field Parties," as submitted in Appendix A, be approved for publication in the Manual.

(3) The committee recommended that the "Manual of Rules for the Guidance of Employees of the Maintenance of Way Department," as submitted in Appendix B, be approved for publication in the Manual.

(4) The committee recommended that the report on "The Science of Organization," as submitted in Appendix C, be approved for publication in the Manual.

Committee: W. C. Barrett (L. V.), chairman; H. H. Edgerton (C. G. W.), vice-chairman; F. D. Anthony (D. & H.); E. H. Barnhart (B. & O.); H. L. Browne (C. B. & Q.); J. B. Carothers (B. & O.); S. E. Coombs (N. Y. C.); R. H. Gaines (T. & P.); R. H. Hallsted, H. H. Marsh (B. & O.); B. Herman (Sou.); F. D. Lakin (Erie); E. L. Martin (M. K. & T.); Jos. Mullen, W. H. Rupp, P. T. Simons, H. E. Stansbury (E. P. & S. W.); R. E. Warden (M. P.); A. A. Woods (Sou.)

Appendix C—The Science of Organization

Up to the present, organization has developed as an art rather than a science and has brought out two general types, viz., the *line* type and the *staff* type. Line type is exemplified in the army, in which there is a direct connection from the head through each subordinate to the next lower until the worker, if we may so call him, is reached. The staff type is exemplified in manufacturing concerns, where there are specialists who may direct the worker in any part of his work that may be of a nature to be covered by the specialist's knowledge or authority.

The fundamentals of organization are as follows:

1. An organization must have its object clearly defined.
2. In its simplest form organization consists of head and working force.
3. Subdivisions, combinations, extensions and modifications of this form may be made to any extent and may be

most readily shown and understood by means of charts.

4. The head or executive must (a) understand his objective; (b) plan and direct all activities; (c) select and educate working force; and (d) receive results.
5. Executive must have complete authority over working force.
6. Executive may subdivide or delegate his authority, in which case each sub-head must know exactly his duties and responsibilities and there must be an invariable sequence without any conflict in, nor division of, authority and responsibility.
7. There must be harmony in all relations of different sub-heads.
8. There must be interchange of ideas and information between all types of executives.
9. Working force consists of equipment, tools and men, and the economic relations between these must be balanced.
10. Correct discipline is an essential feature of organization.
11. Compensation must follow the human effort in just proportion.
12. Not only physical force is available in any human organization but proper results from item 10, 11 and 4c should develop in such a body an esprit de corps.
13. Co-ordination and correlation of work as to time, place and materials must not only be planned by executive, but he must know that it is accomplished.
14. Sub-heads in the smaller spheres must apply all principles used by the higher executives.
15. Standardization of methods and means must be intelligently applied.
16. Organization charts give the simplest and most readily comprehended means of expressing the system in use.

Discussion

W. C. Barrett (Chairman): The committee was given four subjects on which to make a study and report.

Inasmuch as the action to be taken on subjects 2 and 3 will determine what action will be taken on subject 1, they will be presented first. Mr. Harsh will outline the matter under subject 2.

(H. H. Harsh (B. & O.) presented the report on instructions for the guidance of engineering field parties.)

Chairman Barrett: *I move the adoption of conclusion 2.*

(*Motion carried.*)

Chairman Barrett: While I believe this is the first time subject No. 3 has been presented formally to the Association for approval, it has been before the committee and the Association for a number of years, so that in presenting the Manual of rules for the guidance of employees of the Maintenance of Way Department, the committee is not presenting an entirely new subject. Mr. Barnhart will present this part of the report.

E. H. Barnhart (B. & O.): I will abstract Appendix B.

Chairman Barrett: *I move the adoption of conclusion 3.*

C. W. Baldridge (A. T. & S. F.): I believe I will have to take exception to rule No. 1 to start with. I do not believe it should be the duty of any employee to provide himself with a book of rules. The rules should be altered to read that the employing officer shall provide each new employee with a book of rules and that the employee then should familiarize himself with the rules.

I also notice in reading over the report of this committee, in a great many cases it duplicates the work of other committees already in the Manual and in a few cases conflicts with such work, and I move *that this portion be referred back to the committee, with instructions to co-ordinate the matter on the conduct of work with the work of the other committees, and that the report be brought in next year.*

H. L. Ripley (N. Y. C.): I second the motion and endorse what Mr. Baldridge has said without any intent to criticize the work of the committee. As he has already pointed out, there is conflict in this section on conduct of work with the work of the Ballast committee.

Chairman Barrett: The committee went very carefully over everything that was in the Manual, and so far as we could ascertain, there was no conflict with any other committee's report.

Maurice Coburn (Penna.): I agree with Mr. Baldridge's motion, and there are one or two other portions which should have some consideration. The instructions about "line and surface" seem to be misleading. Under "joint bars" it is said 'Rail joints should be as simple and of as few parts as possible to be effective." These instructions, as I understand it, are for the trackmen with relation to the actual operation and are not for such items as that.

A. S. Baldwin (I. C.): I think it would be a mistake to refer these rules back to the committee. A great deal of excellent work has been done on them and what they are intended for is to be used as a general compendium of rules for the maintenance of way department. It would not be possible for this committee to get up a set of rules that would agree with everything that might be done in the convention after they came in. These rules will be adapted to the special conditions of every railroad, and it will be understood that they are for general use and will be very useful.

I believe it should be the duty of the superior officer to supply the men with a copy of the rules, but the employee should not be able to offer an excuse that he did not carry out the rules because he had not been supplied with a copy, and I think it should be one of his very first duties to supply himself with a copy and then leave it to his superior officer to do likewise.

J. B. Carothers (B. & O.): On behalf of the committee I wish to say that the first question was brought up about the employee providing himself with a book of rules, that is not our thought, we copied that from the American Railway Association standard code. They have been practicing that for a good many years. I do not believe it is necessary to raise that question at this particular time.

C. F. Loweth (C. M. & St. P.): These rules seem to contain a good many duplications. There are five or six rules for bridge and building foremen, mason foremen, painter foremen, that are almost identically the same rules, perhaps in one or two cases there is a change of a word. On many roads the foremen have to do with bridge and building work, and water station work, and are also painter foremen, and plumber foremen, and I am wondering if these rules would not be more effective if they were more simple. Say if we had the various rules I have referred to combined together, and then a paragraph for the particular duties of the particular foreman.

Chairman Barrett: The committee was cognizant of the fact that in preparing rules for these different foremen they would be more or less the same in their reading. We thought it proper to make the rules correspond to one another so that they would be in somewhat the same form, and while there is, perhaps, as indicated, some repetitions, these rules were intended as the groundwork for perhaps very much more extended rules that particular railroads would want, and we thought each one should be complete in itself.

Mr. Baldridge: I will call attention to Rule 274 with reference to broken rails. The rule is very good as far as it goes but it does not go quite far enough, in that a broken rail under present-day conditions should be removed from the track as soon as possible. The committee has finished this rule by saying, "The broken ends of the rail should be connected by joint bars, the rail drilled, and the joint bars full bolted, after which the resumption of traffic may be permitted," but they do not go on to say that the rail should be taken out of the track at the earliest moment. I think we should add a little more

to that rule, and provide that a broken rail must not be left in the track longer than is necessary.

Chairman Barrett: The committee accepts the criticism and will ask permission to add to that paragraph to make it read like this—"After which the resumption of traffic may be permitted with reduced speed. The rail should be removed from the track as quickly as possible."

Mr. Coburn: Will the committee be willing to omit Rule 275?

Chairman Barrett: We will eliminate Rule 275.

The President: If there is no further discussion, a motion to adopt this section of the report as amended, is in order.

Chairman Barrett: *I move the adoption of the report as amended.*

(*Motion carried.*)

Mr. Carothers: The revision of the Manual has been taken care of by the adoption of the other portions of the report, and we have nothing further to offer.

I move the adoption of conclusion number 1.

Chairman Barrett: Subject No. 4 is covered in Appendix C.

(R. H. Gaines (T. & P.) presented an abstract of the report.)

(The committee was excused with the thanks of the Association.)

Report on Records and Accounts

In addition to a number of definitions, Form 501, or monthly track material report, was revised and is presented for inclusion in the Manual. The revised form is the result of a study of forms used on a number of different roads. It is to be 11 in. by 16 in. so as to fold letter size with a one-inch margin for binding. In accordance with Valuation Order No. 3, second revised issue, three additional forms covering estimate sheets, register of authority for expenditure and equipment completion report are submitted for adoption. They are primarily for the carriers, but the requirements of the Interstate Commerce Commission have been kept in mind.

H. M. Stout
Chairman

H. M. Stout is rounding out his first year as chairman and is completing his seventh year as a member of the committee. He is record engineer of the Northern Pacific at St. Paul. He is therefore in intimate daily contact with the work under consideration by the committee and in a particularly favorable position to direct its studies along practical lines. The need for complete and accurate records is being realized more fully now than ever before as the valuation work and the more detailed information required by regulating authorities are extending. The committee is in a position to render a real service to the roads in developing standards to meet these demands.

In Appendix A the committee submitted a number of proposed changes in the Manual.

Three additional forms for recording data for keeping up-to-date valuation of property of railways as required by Valuation Order No. 3, second revised issue, were presented in Appendix B.

Conclusions

1. The committee recommended that the changes in the Manual as given in Appendix A be approved and the revised matter be substituted for the present recommendations in the Manual.

2. The committee recommended that the three additional forms shown in Appendix B, for keeping up records under Valuation Order No. 3, second revised issue, be approved and published in the Manual.

3. The committee recommended that subject (3) in Appendix B be continued as a part of next year's work.

4. The committee recommended that the reports relating to subjects 2, 4 and 5 be received as information and the subjects continued.

Committee: H. M. Stout (N. P.), chairman; Henry Lehn (N. Y. C.), vice-chairman; A. M. Blanchard (G. T.), H. Bortin (Cons. Engr.), W. A. Christian (I. C. C.), R. A. Cook (C. & A.), W. P. Cronican (I. C.), E. B. Fithian (M. P.), L. B. Lincoln (B. & A.), J. H. Milburn (B. & O.), A. W. Neel, H. J. Sargent (Wabash). *R. C. Sattley (C. R. I. & P.), C. W. Simpson (D. L. & W.), T. H. Strate (C. M. & St. P.), V. R. Walling (C. & W. I.), W. D. Wiggins (Penna.).

Appendix A—Revision of Manual

The committee recommended changes in the Manual shown below. Under definitions the new or added letters and words are underscored and the old or omitted letters and words are enclosed in parentheses.

*Died December 31, 1920.

Definitions, Page 339

Account(s).—A statement(s) required to enable payment(s) to be made for labor performed and material furnished, or to establish the detail, total and comparative cost of work and various classes of expenses.

Conventional sign(s).—A symbol(s), such as a mark, character, abbreviation or letter, selected or sanctioned by general agreement or common use (and) to indicate upon a map or plan certain forms, conditions (and) or objects, both natural and structural.

Ledger accounts (for individual pieces of work).—Statements kept in ledger form in order to establish the detail, total and comparative cost of (any particular) individual pieces of work or classes of expenses.

Progress profile.—A graphical record (of the progress) showing status of work (prepared) at stated periods.

Record(s).—Authenticated information or data in graphical, tabular or statement form relating to physical characteristics, conditions, cost and such other information as may seem desirable for (record) preservation.

Report(s).—The medium through which information is transmitted (from one to another official) and from which records and accounts are prepared or compiled (in the filing office).

Right-of-way map.—A plat representing the actual location and dimensions of the property, (right or) franchises or other rights (that are) owned or controlled by a railway company.

Track chart.—A diagram showing the physical characteristics (of track and roadbed) roadway and track.

Track map.—A (map used primarily for) plat showing existing physical (conditions) plant, including tracks, bridges, buildings, water service and mains, leases, station facilities

and all (of the) other physical and operating (features) property.

FORM 501, MONTHLY TRACK MATERIAL REPORT

The forms in use on the 23 railroads have been examined to determine what, if any, changes should be made in the form as published in the Manual. Eleven of these reports were bound in book form, in some cases being combined with time books and tool reports. The principal features in which these forms differ from the form in the Manual are as follows:

Four roads use separate forms for recording ties, rail, and miscellaneous track material; three roads divide the columns showing material received from track into fit and scrap; the Norfolk Southern and Bessemer & Lake Erie have a simplified form using only five columns. Some roads use an alphabetical arrangement of the material in the left-hand column, and one road prints the material in columns reversing the use of the lines and columns. Pittsburgh & Lake Erie prints a list of 232 items on four sheets, and furnishes a blank sheet for additional items; the Pennsylvania has a form with 40 columns. The form in the Manual is followed closely by the Chicago & Western Indiana, the Chicago, Rock Island & Pacific, the Missouri, Oklahoma & Gulf, and the Minnesota, Dakota & Western railroads.

The list of materials in the left-hand column will vary on different railroads and should be omitted entirely, and left to be filled in by printing or in pencil, according to requirements of individual railroads. The headings of the columns on Form 501 in the Manual seem to meet the requirements of a form of this kind, except that we suggest dividing column five (5), showing material received from track, into two columns, showing main tracks and side tracks; changing columns 10 and 11 to three columns, in order to itemize material used on different construction jobs, and divide column 12 into three columns in order to report material shipped to various divisions or destinations.

On the back of Form 501 are instructions, daily record of material received and shipped, and switch tie data. The instructions should be printed on the face of the form. The daily record of material received and shipped does not seem to be necessarily a part of this blank. The switch ties might be included in the items on the face of the sheet, with details in a separate table, if desired. It was recommended that the form be revised to be made 11 by 16 in., so as to fold once to lettersize with a one-inch margin for binding. The form to be printed in black with horizontal lines, 6 per inch. Instructions to be printed at the bottom of the sheet as shown.

Discussion

(Chairman Stout read the subjects assigned to the committee), and said:

The form in Appendix A, which is being proposed now to be substituted for that previously submitted and published in the Manual follows the practice which we have adopted of having forms as far as possible printed on one side only. Any descriptive matter or instructions to be shown on the face of the form.

I move the approval of the committee's recommendations for changes in the form and that the matter submitted in Appendix A be substituted for similar matter now in the Manual.

(Motion Carried.)

Chairman Stout: With reference to subject No. 2, as stated, the sub-committee which has been handling this subject has continued their work, but do not have the matter in shape for presentation at this time, so that no conclusions are offered.

We will pass to subject No. 3. Last year you will recall there were some four or five blanks submitted, some of them directly bearing upon the order itself, and some of them requiring supporting data. This year we are submitting three additional forms.

H. L. Ripley (N. Y. H. & H.): Since the first days of December I have been spending much of my time in connection with this matter, which has to do with the I. C. C. Order No. 3. It may be the intention of the committee to present these forms and collect certain data, but I believe there will be a circular issued soon by the I. C. C. to cover that subject. It may not be known to the committee that new forms have been prepared illustrating what is required under that order of the Commission. The joint standing committee composed of three representatives of the carriers and two or three representatives of the Bureau of Valuation have been appointed to consider this matter, and I would question the expediency and perhaps the propriety at this time of adopting this Appendix B for inclusion in the Manual.

O. E. Selby (C. C. & St. L.): I want to call attention to the Register of Authorities for Expenditure. It carries under the third column a D. C. E. reference. That refers to the period of federal control and is not necessary now.

Chairman Stout: The column carrying the D. C. E. reference is only inserted there to continue matters which are not yet closed out, some of which were initiated under government control, and it is not the intention to perpetuate that. As soon as we entirely get away from that period the D. C. E. reference will automatically drop out.

In answer to Mr. Ripley's suggestion, we recognized at the time that Order No. 3 may be in a somewhat tentative condition, still it does to some extent become fixed, and we felt that these forms were so nearly like those prescribed in Order No. 3, and since these particular forms were not specified by the I. C. C. Bureau of Valuation, that considerable leeway was given for additional information. They specify only the minimum amount of information required, and we thought we were justified in presenting the forms at this time.

Mr. Ripley: I really feel I would be embarrassed rather than helped by the adoption of this Appendix B as it is presented, still what the chairman has said is true. There was prepared and handled by the secretary of the President's Conference Committee a new series of forms arranged in considerable detail and differing substantially from the old forms, and I may say if it had not been for the intervention of the carrier's committee, these forms would probably be before you in mandatory form. We ask for an opportunity to suggest modifications in these forms. I do not know how much consideration the committee has given to it, but we spent weeks on this thing and these forms do not go far enough and I would like to make the suggestion that this Appendix B be received for information, rather than for adoption and printing in the Manual.

The President: The committee desires to change its recommendation that this subject be continued and that neutralizes the motion made for adoption. The motion for adoption has been withdrawn by the mover.

Chairman Stout: Subject No. 4 is under consideration and no conclusions are presented at this time. Subject No. 5 is also under consideration and definite conclusions have not been prepared. In Appendix C in connection with that study will be found a very valuable bibliography covering the subject assigned. This has been prepared in large part by the Bureau of Railway Economics, and we feel we are fortunate in getting their assistance in this manner.

Mr. President, this matter is presented for information.

(The committee was excused with the thanks of the Association.)

Report on Conservation of Natural Resources

The results of the reclamation of scrap and material on the Wabash, the Santa Fe and the Baltimore & Ohio are presented with the idea that the information will be not only of value, but that it will stimulate still further interest and thus effect greater economies. The Wabash shows a saving by reclamation of approximately $17,000 in about one year. Railways should encourage every method to maintain and increase forest growth, as they are directly benefitted by the increased revenue as carriers of timber and by the increased supply for their own needs. The roads should plant trees along the right-of-way to eliminate snow fences, and promote tree planting.

W. F. Ogle
Chairman

W. F. Ogle is completing his first year as chairman and his third year as a member of the committee. In directing the work of this committee, it is necessary for the chairman to differentiate between the theoretical or intangible and that of immediate practical application. In these days of intensive search for the elimination of waste of every character as opportunity is offered for constructive work by this committee. Mr. Ogle is a relatively recent member of the Association. He is chief draftsman in the office of the chief engineer of the Chicago, Rock Island & Pacific at Chicago.

In Appendix A the committee submitted its report on the reclamation of materials. In Appendix B the committee submitted its study of the subject of tree planting and reforestation. It is the judgment of the committee that greater interest should be manifested by both state and federal governments in this subject, by enacting more lenient tax laws on growing timbers, and making appropriations for acquiring denuded lands, unsuitable for agricultural purposes, which should be reforested. A report on the conservation of human life and energy was presented in Appendix C.

Committee: W. Forrest Ogle (C. R. I. & P.), chairman; E. E. King (Univ. of Ill.), vice-chairman; F. T. Beckett (C. R. I. & P.), C. M. Buck (A. T. & S. F.), Moses Burpee (B. & A.), J. R. Caswell (C. P.), O. P. Chamberlain (C. & I. W.), J. B. Dawson (S. P.), W. A. Duff (Can. Nat.), C. H. Fisk, F. A. Gaby, R. H. Howard (Wabash), William McNab (G. T.), J. B. Myers (B. & O.), J. L. Pickles (D. W. & P.), S. N. Williams (Cornell College), R. C. Young (L. & N.).

Appendix A—Reclamation of Material

On the Wabash, during a period from August 19, 1919, to July, 1920, inclusive, new material costing $24,702.73 was reclaimed at an expense of $7,396.45, effecting a saving of $17,306.28.

These figures cover such track material as clawbars, lining bars, pinch bars, track chisels, track spikes, guard rail clamps, head rods, connecting rods, switch stands and targets, derails, etc.

The following is an illustration as to the accounting procedure:

(1) All material delivered to reclamation plant is accepted as miscellaneous scrap, whether it be tools, couplers, bolsters, switch stands, etc.

(2) Material in some cases is worked over into other items from its originality or it is repaired, or rebuilt by applying to new parts, etc.

(3) The cost of labor in repairing and assembling is charged direct to the particular item or material that has been handled.

(4) To the cost of labor is added the price of miscellaneous scrap used.

(5) To the cost of labor, new material and scrap also a pro rata charge is applied to the various items on percentage basis. This pro rata represents overhead charges, i. e., supervision, oil, power, light, telephone, and water. In other words, covering such expenses that cannot be accurately charged direct to any one item of material.

(6) Recapitulations of all charges are brought forward, which makes the total cost of reclaiming, we being allowed either current or contract prices for all material or, in other words, new value.

(7) The total cost of reclaiming any one item is deducted from the new value, which leaves the net saving as compared with new value.

On the Santa Fe if a switch stand can be repaired credit is allowed to the division from which it came at the price of the new stand, giving the stand a symbol, and when it arrives on the dock after going through the shop it has been charged with the time of each man's work and with the material used; then the office charges the division from which the stand comes with the actual cost of repairs, and by this method the division receives credit for the true value of the stand. All materials received are handled in this manner. If a frog is received that is good for nothing more than scrap, credit is allowed for any parts that are serviceable, such as clamps, fillers and rods. Clamps at $3 each, cast fillers at $1.50, steel fillers at $3, and 25 cents each for the rods. The Santa Fe has repaired:

31 box stands at a cost of	$4.13 each.	Total, $128.19.
6 low star stands at a cost of	$3.31 each.	Total, $19.87.
1 high star stand at a cost of	$6.84 each.	
32 switch stands at a cost of	$3.05 each.	Total, $97.95.

Reclaiming Repair Rail by Resawing

It has been the policy of the Baltimore & Ohio to lay new rail out of face on important high speed passenger divisions and those carrying heavy traffic, renewing the worn rail, which is often of lighter weight, and relay the repair rail on branch lines where the passenger movement is less frequent and speed considerably lower, or on such branch lines where the traffic consists almost entirely of slow heavy freight trains. Therefore, in the relaying of these four different weights and sections, each has been assigned to some one branch line, consideration being given to the traffic over that line. In relaying this sawed-end rail on branch lines, it is laid with new bolts and bars. In resawing the rail, 15 inches is cut off each end of the rail. After the rail is sawed it is 30 ft. 6 in. long and is redrilled. When this sawed-end rail is laid on branch lines, as above detailed, the bad features of worn surface and line bent at ends and worn angle bars, which were always objectionable features to relaying rail, are entirely eliminated.

When relay rail arrives at the plant it is unloaded on skids, where it is handled by a stiff leg derrick, with the assistance of four laborers, to the saw table. The rail is

then sawed by friction saw, one end at a time. After both ends are sawed it is moved on rollers by hand to the double drill presses, where it is drilled. In drilling, the ends of four rails are drilled at one operation. The burrs are knocked off by the men handling the rail on its way from the saw to the drill presses and at the drill presses.

During the calender year reported on there has been sawed a total of 499,137 ft. of the four different sections, representing the total number of feet of rail after it is sawed and drilled equivalent to a tonnage of 7,192. In the sawing of the rail there was about 8 per cent lost which will be sold as scrap. The average cost of sawing this rail during the year was $1.27 per ton. This cost includes all labor for unloading the rail at the saw; the labor and other direct costs incident to the actual operation of sawing the rail, and the labor cost of loading the rail into cars. This cost does not include the labor costs of loading the rail for shipment to the saw or the unloading of the sawed-end rail on the ground for laying. The loss on account of sawing off the ends of the rail or its credit when sold as scrap is not considered in the average cost previously given.

Appendix B—Tree Planting from Railway Standpoint

But few roads own land on which to carry out any experiments in this line, but many roads traverse tracts of country which are not productive of any crop, and which, even where soil is unfit for agriculture, might support a fair forest growth.

Railways are not only vitally interested in the timber supply for their own maintenance, but also in a very great degree in the amount of traffic which timber furnishes to them as carriers. It is fitting, therefore, that they should encourage and originate all possible means to maintain or increase forest growth. In the majority of cases, however, railway companies have no authority in forestry matters. It is time, and we are glad to know it, that the owners of wood lands are becoming more careful and more enlightened as to conservation of their properties, yet the problem of reforestation is scarcely getting the attention it deserves.

The railways, together with state and federal governments, should urge farmers and other land owners to utilize their waste, burnt over and cut over lands by planting trees. Co-operation in this way would furnish a large part of the timber required for buildings and roadway maintenance, for car construction and repairs, for paper used in various forms, and will materially aid in solving the fuel supply. Since they are such extensive users of forest products, the railways could well afford to have a sufficient forestry staff to help in carrying out a comprehensive planting program. The different states through their forestry officers could be called upon to assist in this work. By a series of demonstration lectures, newspaper articles and other publications, the land owners could be shown the benefits of such an undertaking, and could be taught the best methods of planting, growing and cutting timber and of protecting it against fire, insects and diseases.

Rough lands where the timber has been removed are being denuded of their soil by rainfall and their productiveness is being decreased. This is of vital interest to the railways, for most of them derive their incomes from the products along their lines. Many of the excessive floods that have brought much damage to railway property in recent years were aggravated by the lack of growing timber. Most of the trees that formerly grew along the streams and that checked the flow of water before it reached the streams and prevented much of it from getting to them at all, have been cut away. Wherever possible, these lands should be reforested to save the soil, to conserve the rainfall and to eliminate some of the damage from the floods.

The railways should plant trees along the right-of-way where there is difficulty with drifting snow, to eliminate snow fences. They should encourage land owners to plant trees for shelter belts where it is apparently not possible to get other plantings started at the present time. This would demonstrate what could be done in raising timber and would furnish for them a fuel supply.

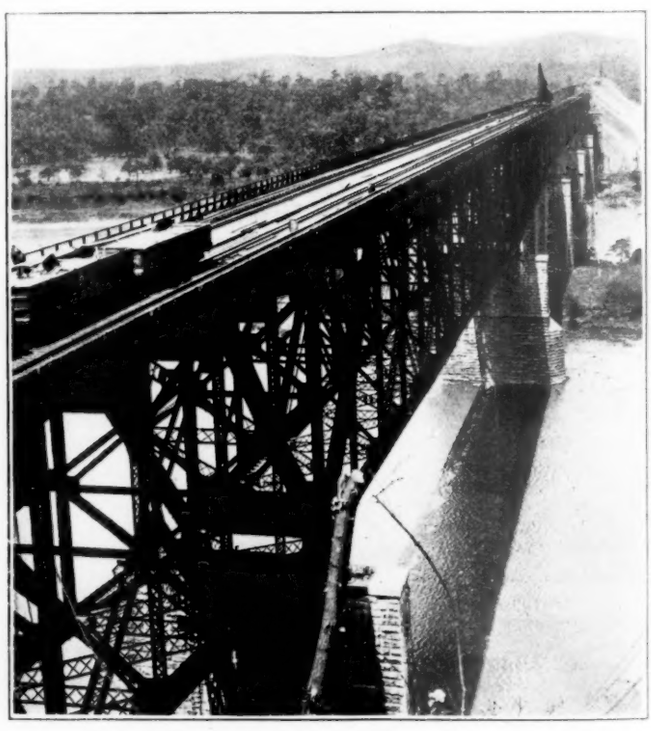
Discussion

W. F. Ogle (Chairman): The committee had no recommendations to make in regard to what had previously been published in the Manual. Under Appendix A we have shown a few examples of how reclamation of materials could be practiced. I think it is needless to say that most engineers today realize that there is great saving to be made through reclamation of materials, and the field is so large that it is really up to the individual to practice it as he can do best on his own lines.

Tree planting and reforestation is an old subject. It has been gone over and over, and there is little left to be said. I think the thing that we should do is to encourage proper legislation to regulate tree planting and reforestation.

In Appendix C we have attempted to show under several headings a few of the methods which should be followed in the conservation of human life and energy. That also is quite a large field. Under Appendix D we have shown some of the progress in reforestation and conservation in Canada, which is very similar to conditions in this country.

(After brief discussion the committee was dismissed with the thanks of the Association.)



A Notable Bridge on the Bessemer & Lake Erie

Report on Yards and Terminals

Typical plans for tracks and ladders leading to stub-end and through passenger stations are submitted for inclusion in the Manual. In transfer of lading of bad-order cars, hand labor is without real justification. Locomotive cranes can generally be used with economy. Intensified use of property is secured by multiple story freight houses. Two-track level freight house design is attracting increased attention. For the mechanical handling of freight in freight house work the most extensive and successful development has been that of small tractors and trailers. Automatic elevators have been applied with success at railway, commercial and army warehouses.

B. H. Mann
Chairman

B. H. Mann has been chairman of the committee for three years. Prior to that time he was vice-chairman for four years. He has therefore held a position of responsibility for 7 of the 11 years he has been a member. The fact that he is signal engineer of the Missouri Pacific system is an indication of the increasingly close relation which signal engineering bears to the solution of operating problems. The experience which he has gained in his regular work is of particular value to the committee which has for its goal the development of the principles of economical terminal operation and the presentation of plans and methods for this object.

In Appendix A the committee submitted the results of its study of the subject of handling of freight on two-track level freight houses and team tracks, including multiple-storied freight housts and handling of freight by mechanical means. In Appendix B the committee reported its continued study of the subject of typical and actual situation plans for passenger stations and methods of their operation showing plans and photographs of the St. Paul Union Station at St. Paul, Minn., and the passenger terminal at Richmond, Va. It also reported on the subject of economic transfer of lading of bad-order cars in large terminals by the introduction of mechanical means or otherwise. Progress was reported on the study of subject (2) Unit operation of railroad terminals in large cities; on subject (5) Classification yards, including methods of switching; on subject (6) Advantages of small sorting yards and gravity switching for switching trains into station order and in Appendix C, the compiling of specifications for passenger, freight house and grain weighing scales.

Conclusions

1. The committee recommended that the following plans, taken from the Proceedings and revised, be approved for publication in the Manual:

Typical and actual situation plans for passenger stations and methods of their operation:

(a) Plan showing a typical track layout at a dead-end passenger terminal station.
(b) Plan showing a typical track layout at a through passenger terminal station.
(c) Plans Nos. 20 to 26, showing types of ladders for passenger stations.

2. The committee recommended the following for approval and publication in the Manual:

Methods of economic transfer of lading of bad-order cars in large terminals by the introduction of mechanical means or otherwise:

(a) Hand labor for transferring freight from cars in most cases is slow and expensive and without real justification.
(b) The employment of a locomotive crane is generally justified in any case where the transfer of freight from open-top cars otherwise requires the equivalent of the constant daily service of six or more men, or the intermittent service of six men where the machine may be economically employed in the interim.
(c) A study of each situation may develop extensive means of economy out of all proportion to the cost and such study is justified in each case.

3. The committee recommended that its report on the subject of handling freight in two-track level freight houses and team tracks be received as information.

Committee: B. H. Mann (M. P.), chairman; A. Montzheimer (E. J. & E.), vice-chairman; J. E. Armstrong (C. P. R.), Hadley Baldwin (C. C. C. & St. L.), C. A. Briggs, J. H. Brinkerhoff, Miles Bronson (N. Y. C.), A. E. Clift (I. C.), L. G. Curtis (B. & O.), H. T. Douglas, Jr. (C. & A.), A. W. Epright, E. M. Hastings (R. F. & P.), Reuben Hayes (Sou.), L. J. F. Hughes, J. B. Hunley, (C. C. C. & St. L.), D. B. Johnston (P. L. W.), H. A. Lane (B. & O.), R. J. Middleton (C. M. & St. P.), O. Maxey (C. R. I. & P.), F. E. Morrow (C. & W. I.), H. J. Pfeifer (T. R. R. of St. L.), S. S. Roberts, C. H. Spencer (I. C. C.), E. B. Temple (Penna.), E. E. R. Tratman (Engr. News), J. G. Wishart (C. R. I. & P.).

Appendix A—Multiple-Storied Freight Houses

The subject of multiple-stored freight houses divides itself into four parts:

(1) Two-track-level freight houses as compared with single-level freight houses.
(2) Two-track-level team tracks.
(3) Multiple-storied freight houses, or the operation of storage warehouses in connection with freight houses.
(4) Handling freight by mechanical means.

The committee has been unable to find any installations of two-track-level freight stations. Assuming that a two-level design is adopted, one of the first considerations is adequate provision for handling freight between the two levels. Elevators are the principal means employed, handling both freight packages and freight trucks, although inclined conveyors or escalators have been proposed in some cases.

As to the general plan, the almost universal arrangement is to have both tracks and driveways run longitudinally with the building, with the platforms on the upper level directly above those on the lower level. In a design made in 1912 by the Pennsylvania for a large freight terminal at Chicago the freight house was to cover an entire block and to have transverse driveways connecting the two streets on the longer sides, thus increasing the length of frontage for teams. This project was abandoned, however, in favor of the present terminal with longitudinal driveways.

Two-Track-Level Freight Houses

Double-deck freight house design is attracting increased attention in connection with railway terminal facilities in large cities, especially where separation of grades of tracks and streets involve steep grade approaches for single story freight houses. The floor area of many single-

level freight stations is inadequate for their business, but expansion is either impossible or is practicable only at great expense for additional land. In such cases the introduction of the two-level type of station may furnish a satisfactory solution of the problem, also being adapted to separation of grades, reducing congestion of vehicles, avoiding steep driveways and shortening trucking distance, the latter being one of the principal factors in the expense of freight house operation.

Two-level stations have been and are being built under governing conditions such as are imposed by topography, grade separation or the necessity of intensified use resulting from restricted area or high value of land. Where conditions permit of choice between single or multiple level designs, selection should be based upon these considerations: (1) Value of land; (2) construction costs; (3) present and future business; (4) operating costs, and (5) operating capacity.

Multiple-Storied Freight Houses

This subject relates to the provision of upper stories for holding of inbound freight until delivered or for warehouse purposes. Some railway officers do not favor going into the warehouse business; the committee held, however, that where the freight house occupies land of high value it is desirable to develop revenue from the area occupied, increase traffic, and offer economy to shipper, providing that this can be done without interfering with the normal business of the railway.

One objection that has been made is the possible confusion between teams for freight house and warehouse business, and confusion in the elevator service handling both kinds of business. In this connection reference may be made to the combined freight station and warehouse of the Central Manufacturing Company at Thirty-ninth and Robey streets, Chicago. The tracks are at the first-floor level, and two outside tracks along one side are for the carload business of the warehouse. Along the other side is a double deck driveway, the lower deck serving the freight house platform and the upper deck serving the warehouse. Access to the upper deck is by two large elevators for wagons and motor trucks. Some of the interior elevators serve the warehouse floors only, and others serve both the warehouse and the freight station.

The new five-story freight terminal of the Pennsylvania at Chicago has tracks at the basement level and team driveways on the first floor, with the three upper stories designed for warehouse purposes. The new Chicago freight stations of the Chicago & Alton and Chicago, Burlington & Quincy will have a similar arrangement, the Chicago & Alton having one warehouse floor, the Chicago, Burlington & Quincy four. The Orange Street freight station of the New York Central Lines at Cleveland, Ohio, is of the single-floor type with provision for future upper floors for warehouse purposes.

Mechanical Handling of Freight

Two difficult conditions are involved in attempts to simplify the operation and to introduce mechanical methods of handling. In the first place, there is the network of movements. Outbound freight from each doorway must go to a scale and checker's desk and then to any one of the cars which stand alongside the house. In the second place, the freight to be handled is of bewildering variety in material, size and weight.

Hand trucking has met the requirement of flexibility of movement fairly well, but it is slow and expensive, and involves considerable confusion, with liability of numerous errors. Overhead cranes, trolley hoists and conveyor equipment has been used very little in freight house work. In fact, it has been difficult to adapt such appliances to this work, since their operations are limited to fixed routes and directions and cannot generally be adapted to the irregular and changing directions of movements on a freight house floor. In warehouse work, however, such mechanical equipment finds numerous applications.

For the mechanical handling of freight in freight house work the most extensive and successful development has been the introduction of small tractors to haul trucks or trailers in trains. The tractor taking a train of loaded trucks drops them at their destined cars and collects empty trucks for delivery to loading points.

This system is in operation at a number of freight houses and also at warehouses. To enable the truck trains to cross the tracks between station platforms, light bascule bridges are employed in the Orange Street freight house of the New York Central Lines at Cleveland, Ohio. In settling cars on the house tracks they are spotted to clear these bridges. In the U. S. Army warehouse at Brooklyn, N. Y., the truck and tractor system is operated in combination with an automatic elevator service.

Automatic elevator service is a development of elevator equipment which has been applied with marked success in some of the busiest railway, commercial and army warehouses. It requires no operators on the elevator cars, in ordinary railway installations the elevators being operated by the freight handlers by means of push buttons at the elevator doors. As applied at the Brooklyn Army warehouse, however, one dispatcher at a desk equipped with a battery of signal lights controls all movements and has before him the record of movements and location of all elevator cars. In any case the operation of the doors and the leveling of the cars at the landings are effected automatically. The Pennsylvania freight station at Chicago has 16 of these automatic elevators of three to five tons capacity, and the new Chicago & Alton station at Chicago will have 17 five-ton and two ten-ton automatic elevators.

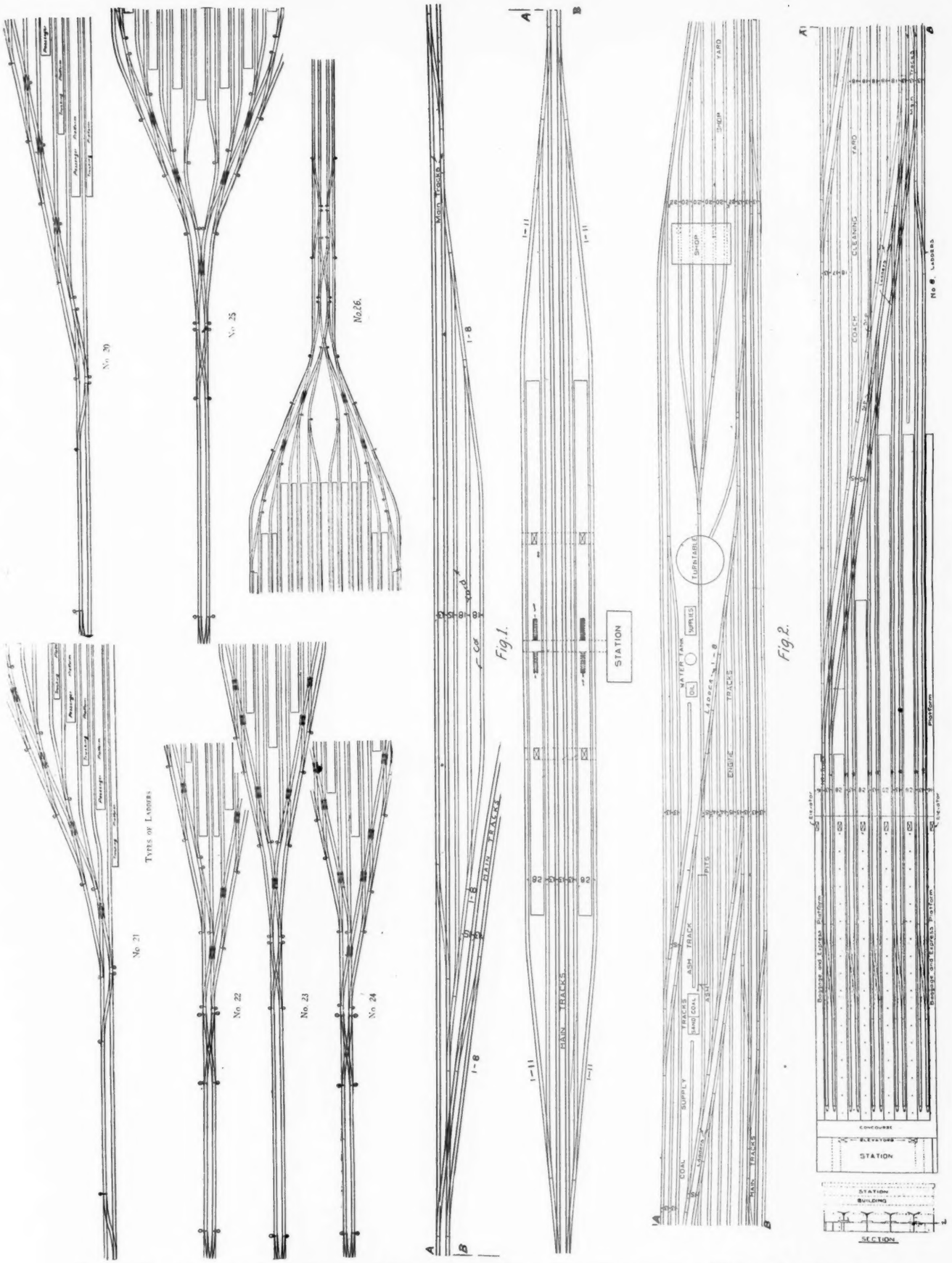
Discussion

B. H. Mann (Chairman): We will take up the report as shown under conclusions. The first two conclusions call for action by the Association. The rest are presented as information. Conclusion (1) will be handled by Mr. Hastings, chairman of the sub-committee.

E. M. Hastings (R. F. & P.): We were charged with the making of a final report, if practicable, on typical situation plans for passenger stations and the methods of their operation. The committee, however, feels that it was not advisable to make a final report, as this is a subject which covers a large field and a work which is consequently in the process of development, consequently it followed out the idea of reporting passenger terminals of interest that have been recently constructed.

We present as information the plans of the union passenger terminal at St. Paul, built by the St. Paul Union Depot Company, and also the plans and photographs of the Richmond, Va., terminal, which has been in operation about two years. We ask you to study these two situations, as they present some very unique ideas.

We present to the Association for approval and publication in the Manual a typical track layout of a dead-end passenger station, which was published in the proceedings of the Association in 1911. This has been slightly revised. Also a typical track layout for a through passenger station, published some time ago. These two plans, slightly revised, are now presented to the Association for adoption and inclusion in the Manual, as are also the types of ladders particularly applicable to passenger stations, which were originally prepared by Mr. Roberts, presented to the Association and printed as in-



Typical Track Layouts for a Dead-End Passenger Station, a Through Passenger Station and Ladder Tracks

formation in 1917. These types of ladders have been slightly revised.

Chairman Mann: *I move that these situation plans be adopted and approved for publication in the Manual.*

(Motion carried.)

Chairman Mann: Conclusion 2 covers subject 8. *I move the adoption of the conclusions for insertion in the Manual.*

(Motion carried.)

Chairman Mann: Subject 3 will be presented by H. T. Douglas, chairman of the sub-committee.

(H. T. Douglas, Jr., (C. & A.) presented Appendix A.)

Chairman Mann: The next subject, on scales, will be presented by Mr. J. B. Hunley.

(J. B. Hunley (Big Four) abstracted the report), and said:

We decided first that grain-weighing scales could not be considered along with the others. At that time we started to adopt a specification for a portable type of scales, of the self-contained and of the built-in type, and the motor truck scales. We found a good many complications. In the first place, the manufacturers, while they manufacture railroad scales and many other classes of scales, find that the railroads are small consumers. We realize that it would be better, if possible, to recommend certain sizes and capacity of scales which will meet practically all conditions, and accordingly a questionnaire was sent to all the railroads. We found that they were using various sizes and capacities of scales, and while we could have adopted certain of these sizes and capacities which the manufacturers were making at that time, we realized that the situation might bring out different classes of scales, and the manufacturer naturally objected to scrapping the old patterns and designs. We found there was but little information as to the weight of motor trucks. However, a great deal of information was collected, and afterward we could not always agree with the manufacturers, and many times the committee could not agree. We hope to have a tentative specification to submit at the next convention. I understand that the A. R. A. has adopted a specification for grain-weighing scales recently.

Chairman Mann: We had hoped to submit a completed report of subject 2, but it has not been possible to do that. Mr. Montzheimer will give details.

A. Montzheimer (E. J. & E.): Last year this committee made a progress report on the unit operation of railway terminals in large cities. It was hoped that we could make a final report on that subject this year, as well as revise the catechism on the operation of terminals as a statement of principles. On account of the change from government operation to private operation it was impossible for us to make a final report on this subject, and we would like to have the matter carried over another year with the hope that we can make the final report at that time.

(The committee was then excused with the thanks of the Association.)

Closing Business

The Chairman: I will ask Mr. Morse and Mr. Baldwin if they will be good enough to escort the incoming chairman to the platform.

(President-elect L. A. Downs was escorted to the platform.)

The Chairman: Mr. Downs, you have been unanimously elected president by this Association for the coming year. You may take that to be a recognition of good service. You may take it also to be an expression of confidence in your ability to direct the work of this body in a successful manner, about which there could be no doubt. It is a pleasure to me to turn over to you the symbol of your office, and in doing so I want to say to you that your success is going to depend a great deal upon your own efforts, true, but it depends a great deal upon the support of your associates, and I can assure you from an experience of one year that that support is always to be had, and it has been helpful in this, the most successful meeting we have ever had. I am glad to present you with the symbol of your office and to say that I am at your service at any time.

President Downs: I appreciate more than I can tell you the honor conferred upon me in electing me president of this Association. I cannot let the opportunity go by without mentioning how closely Mr. Safford's and my life has been associated. We were born in the same state, less than a hundred miles apart, less than two years apart. We were college boys together, we were rodmen together; transit men together; assistant engineers together. We were roadmasters together for a number of years on the same railroad, and neither one of us thought we would ever get away from it. We finally got to the head of the maintenance of way department on the Illinois Central. I say "we." Mr. Safford was chief engineer and I was top sergeant. We then separated in 1910, and for four years now we have both been directors of this Association.

I mention all these things from the fact that now we have passed through the best year the Association has ever had, with the peak reached in attendance. I feel that during the coming year, with the inspiration of the long history behind the Association, I will do nearly as well as my predecessor. I assure you that I will serve you to the best of my ability.

If there is no further business the 22nd annual meeting of the American Railway Engineering Association has now come to a close.

A. R. E. A. Registration

THE REGISTRATION at the closing session of the convention yesterday totaled 31 members and 19 guests, making a total registration for the three days of the convention of 650 members and 165 guests, or a combined total of 815. This total of 815 members and guests compares more than favorably with the attendance of 759 of last year.

Bachelder, F. J., Consulting Engineer, Chicago.
Bainbridge, C. N., Engr. Design, C. M. & St. P., Chicago.
Bakhshi, S. R., Asst. Ch. Draftsman, C. B. & Q., Chicago.
Bayer, E. J., Engr. M. of W., Big Four, Galion, Ohio.
Carroll, G. A., Div. Engr., C. R. I. & P., Eldon, Mo.
Chency, B. M., Gen. Insp. Per. Way, C. B. & Q., Chicago.
Coons, P. D., Asst. Val. Engr., C. B. & Q., Chicago.
Copeland, R. D., Asst. Engr., Wabash, Moberly, Mo.
Dick, H. B., Dist. Val. Engr., B. & O., Cincinnati, Ohio.
Ellis, P. O., Accounting Engr., M. K. & T., St. Louis, Mo.
Gelwix, D. E., Dist. Engr., St. L.-S. F., Springfield, Mo.
Haggander, G. A., Bridge Engr., C. B. & Q., Chicago.
Heggie, W. G., Office Engr., G. T., Detroit, Mich.
Hobbs, W. H., Asst. Engr., M. P., St. Louis, Mo.
Howard, R. H., Ch. Engr. M. W., Wabash, St. Louis, Mo.
Irwin, A. Chas., LaGrange, Ill.
Keough, R. E., Asst. Engr. M. W., C. P., Montreal, Canada.
Kern, J. W., Jr., Roadmaster, I. C., Water Valley, Miss.
Lewis. E. M., Engr. M. W., C. G. W., Des Moines, Ia.
Lynch, H. A., Asst. Engr., B. & O., Wheeling, W. Va.
Metcalf, J. M., Prin. Asst. Engr., M. K. & T., St. Louis, Mo.
Paul, C. E., Prof. of Mech., Armour Inst. of Technology, Chicago.
Penfield, W. H., E. M. Way, C. M. & St. P., Chicago.
Poland, W. B., Manager European Technical Advisers, New York City.
Robinson, R. B., Engr. M. W., Sante Fe, Chicago.

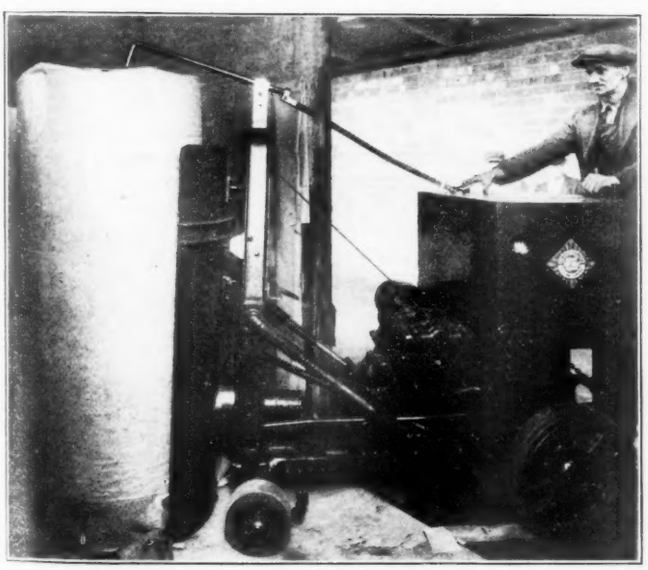
Rohbock, W. L., Ch. Engr., W. & L. E., Cleveland, Ohio.
Snyder, H. G., Asst. Div. Engr., B. & O., Garrett, Ind.
Tuthill, Job, Ch. Engr., P. M., Detroit, Mich.
Wardle, J. D., Ch. Engr., C. R. & I., Cedar Rapids, Iowa.
White, R. C., Gen. Supt., M. P., St. Louis, Mo.
Wilbur, O. G., Pilot Engr., B. & O., Baltimore, Md.

Guests

Baker, Charles, Asst. Engr., M. K. & T., St. Louis, Mo.
Breed, C. W., Office Engr., C. B. & Q., Western Springs, Ill.
Brown, N. W., Draftsman, M. K. & T., St. Louis, Mo.
Elmore, P. W., Asst. Div. Engr., B. & O., Dayton, Ohio.
Fisher, H. L., Sales Mgr., A. C. Horn Co., Chicago.
Fox, M. P., Supervisor, B. & O., Washington, Pa.
Gillen, M. E., Field Acct., G. T., Detroit, Mich.
Hershey, Q. W., Heavy Traction Representative, W. E. & M. Co., East Pittsburgh, Pa.
Kellenberger, K. E., Railway Age, Chicago.
Lichtenwalner, Glen, Instrumentman, G. T., Battle Creek, Mich.
Lillie, J. S., Land & Tax Agent, G. T., Detroit, Mich.
Montz, J. M., 1st Asst. on Corp., B. & O., Seymour, Ind.
Pease, B. S., Manager Concrete Reinforcement Department American Steel & Wire Co., Chicago.
Powell, A. T., Engineer, G. T., Detroit, Mich.
Reinere, W. A., Asst. Prof. Civil Engr., Armour Institute, Chicago.
Staley, G. L., Asst. Bridge Engr., M. K. & T., St. Louis, Mo.
Van Antwerp, E. I., Real Estate Inspector, G. T., Detroit, Mich.
White, S. A., Engr. Acct., G. T., Detroit, Mich.
Wilkinson, J. F., Field Acct., Detroit, Mich.

A New Material Handling Device for Warehouse Use

RAILROADS ACCUSTOMED TO RECEIVE for shipment, transfer or company use, large quantities of roll materials such as newsprint, felt, book paper, sacked wool, baled waste and cotton, barrels of oil, and similar packages which, because of their bulkiness and weight are often hazardous and expensive to handle without special equipment, will be interested in a truck recently developed with special reference to this work. This machine is a combination tractor and truck which is mounted



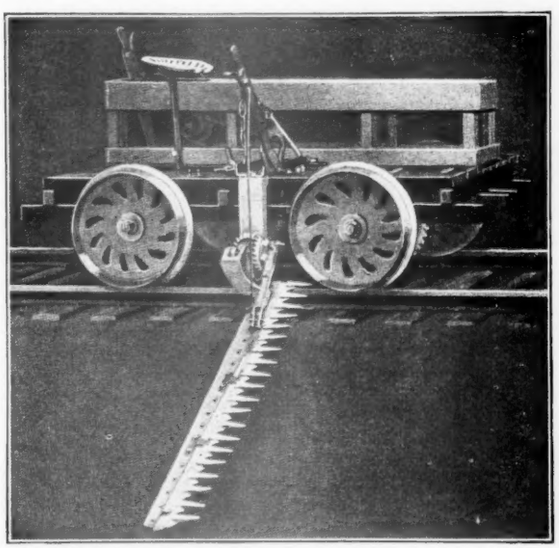
Karry Lode Truck Handling Print Paper

on rubber tired wheels and arranged so that one man, without leaving the platform on the rear of the machine, can load, transport, unload, and even stack such packages. In the case of print paper it is said that the operator can pick up one 72-in. roll or two 36-in. rolls from a prostrate position on the floor of a warehouse or freight car, revolve the load into an upright position, transport them to another section of the warehouse, the tail board of a wagon, or into a freight car, and deposit them on end or side. It is said that the truck will pick up two 36-in. rolls from a horizontal position and stack them vertically, two rolls high, at the rate of 80 per hour.

In this machine the hoisting of the packages is accomplished by means of a single cable from a separate motor-driven hoist, the operator's hook providing the means of holding the material in place during the operation. For purposes of safety such devices are incorporated in the design as will prevent the truck from being started until the operator is on the platform and as will stop the machine immediately upon his stepping off. No fuses are used on the truck, the motor absorbing all the power which the battery is capable of delivering, and accommodation is provided for sufficient battery to carry the machine through the day. The machine is a product of the Elwell-Parker Electric Company, Cleveland, Ohio.

A Track Mower Attachment for Motor Cars

AMONG THE DEVICES now on the market for removing obnoxious vegetation from the vicinity of railway tracks is a mower attachment for motor cars, which has recently been installed on certain large roads. Being a mower, the machine is designed for use particularly in those sections of the country where dense



Motor Car With Mower Attached

growths of rapidly growing weeds are encountered, presenting one means of handling what is generally recognized to be an annoying and frequently quite an expensive problem.

The Rawls Trackmower, as it is called, consists of a meadow-mower type of sickle, attached to and extending directly out from one side of the car, and arranged so that it can be raised or lowered between the bank slopes and a vertical position by means of a hand lever on the floor of the car. The sickle is driven from a gear on one of the car axles, this gear being thrown in or out of engagement by means of a clutch operated by a foot control below the operator's seat, and the ratio of the gears being such that the mower will cut grass, it is said, with the car traveling at speeds as high as 7 or 8 miles per hour. The sickles can be furnished in 5, 6, or 7 ft. lengths, as desired, and are provided with an

automatic feature capable of protecting the blades from damage should they strike an obstruction. The entire outfit weighs about 300 lb. and can be fitted to any hand, push, or motor car. Its mechanism is simple, is said to be very substantial, and is arranged so that the sickle can be detached or replaced quickly. All movable shafts are fitted with renewable brass bushings, and all like parts are made interchangeable.

It is claimed that with no more equipment than the attachment itself, a convenient means is afforded of keeping the track clean throughout the season without requiring the services of extra labor or, where the mower can be operated while the car is making its regular trips over the section, without even diverting the attention of the regular force from other work. It is further claimed that the machine will not only do the weed cutting work far more rapidly than can be done by hand, but will do it more thoroughly. The machine is manufactured by S. E. Rawls of Chicago.

A New Type of Small Pocket Calculator

A NEW POCKET CALCULATOR intended primarily to be used in performing the calculations ordinarily done on a slide rule has been placed on the market by Small, Small & Co., Waltham, Mass. The device consists essentially of a six-inch logarithmetic slide rule, bent in a circle so as to be compact and easily operated. The instrument is made up of a base plate carrying a continuous scale on its periphery and upper face; a movable top plate or rotor arranged to turn on the hub of the first member and carrying a similar scale on its periphery and upper face; a slotted hub nut to keep the rotor in place and adjust the friction, and a runner with a cross hair and pointer for reading the scales.

The "Small" Pocket Calculator

The scales give the function of the angles as well as the logarithmic reciprocals and square roots. These scales are continuous, insuring that the results are always ready, and never off the scale, as often occurs with a straight slide rule. The graduations on the continuous six-inch rim scales are 20 per cent larger than on the double five-inch scales generally used in the ten-inch slide rule. The accuracy is equivalent to a three-place logarithmetic table giving three significant figures. The device is made in two models, No. 1 having the ordinary slide rule scales, and No. 2, intended for architects and structural designers, with scales for determining the strength of steel and wooden beams. The scale on the periphery may be used as a map measure for straight or curved lines.

The instrument is made chiefly of hard non-corrosive metals, the runner being oxidized German silver. The main bearing is tapered slightly with a spring washer to take up the end shake and insure uniform friction. It is claimed that the mechanical construction is such that the changes in temperature and humidity will not affect its operation.

A New Fire Alarm

A NEW DEPARTURE IN FIRE ALARMS has been placed on the market under the name "Fireklock," which is designed to offer a solution for a number of fire alarm problems. The device is automatic in its operation and consists of a bell with a self-contained system of clockwork, controlled by a fusible link.

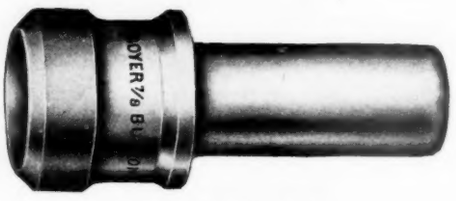
Fireklok Fire Alarm

The principle of its operation is that of a clanging of the bell, once the mechanism is released by the melting of the fusible ling at a temperature of 160 deg. F., the idea being to have the device spread the alarm while the fire is in its incipiency and before it has progressed beyond control by hand extinguishers. Once the alarm starts it rings incessantly for five minutes, after which it may be made ready for use again by inserting a new fusible link and winding up the mechanism.

These alarms occupy a space only five inches in diameter and are intended to be placed in locations where a fire is liable to occur, as in freight rooms, warehouses, paint and oil rooms, etc. This alarm is manufactured by the Pyrene Manufacturing Company, Chicago.

A New Rivet Set

COINCIDENT WITH THE DEVELOPMENT of a reversing type of close quarters drill described in the *Daily Railway Age* of yesterday, the Chicago Pneumatic Tool Company, New York, has introduced a new rivet set for pneumatic hammers. This set, the Boyer by name, is said to be a successful culmination of efforts directed for some time by the company to the manufacture of a tool capable of affording a more uniform and greater resistance to the stress of riveting service than had been obtained in its earlier types. Those recognizing the influence which the rivet set has upon the character and quantity of work and even on the lasting qualities of the hammer, and familiar with the trouble which often attends the use of low grade sets will be interested in the new device, particularly for the possibilities it presents of withstanding service conditions. In this connection it is said that in a series of recent tests, different sets were found to permit the driving of from 12,000 to 20,000 rivets before requiring renewal, all of them displaying great uniformity in performance. Aside from using raw materials subject to rigid specifications, the secret of the success in the manufacture of these tools appears to lie in an accurate control of the forging and subsequent heat-treating processes.



Boyer Rivet Set